INSTRUCTION MANUAL

for

PANORAMIC INDICATOR MODEL SC-8b

PROPERTY OF THE
SPACECRAFT RADIO
ENGINEERING GROUP
SECTION 336

PANORAMIC RADIO PRODUCTS, INC.

MOUNT VERNON, N. Y.

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CHAPTER I
INTRODUCTION

I-1. GENERAL

This Instruction Manual contains information concerning the electrical and physical characteristics, applications, installation, operation, and maintenance of the Panoramic Indicator, Model SC-8b.

No attempt to operate the Indicator should be made until the user is thoroughly familiar with the information contained in Chapter III - OPERATION.

I-2. APPLICATIONS

The Panoramic Indicator, Model SC-8b, in conjunction with a suitable signal generator and mixer, provides a visual automatic spectrum analysis of amplitude modulated (am), frequency modulated (fm), and pulsed systems, crowded communications channels, instabilities of oscillators, noise spectra, and other dynamic phenomena. Non-professional personnel in laboratory or factory can easily use the Indicator once the norms for its application are established. The unit permits selection of center frequency, sweep width, sweep rate, resolution, and type of amplitude indication. The direction and magnitude of conditions, due to changing loads, carrier shifts, mechanical shocks, etc., can be seen instantly. Its wide range of frequency coverage aids in studies of harmonic output.

F-m signals are seen as carriers flanked by their Bessel function sidebands. F-m static deviations may be calculated by noting the zero-amplitude levels of either the carrier or adjacent sidebands. Modulated-signal displays may be used to measure energy distributions and to discover such effects as unwanted or excessive modulations, linearity of deviations, hum and noise, and otherwise undetectable parasitic oscillations.

The variable resolution and variable sweep rate of the Indicator are especially suited to pulsed radio frequency (prf) analysis as in radar systems. The one-per-second sweep rate permits good visual description of low prf dispersions. Provision is made to reduce intermediate frequency (i-f) bandwidth in order to assure adequate amplitude response for narrow pulses. An intensifier is included to brighten pulse displays.

I-3. EQUIPMENT SUPPLIED

The equipment listed below is supplied either in individual cabinets or in rack mounting assemblies:

	Quantity
Indicator, Model SC-8b	1
Power Supply, Model PS-8b	1
Constant Voltage Transformer, T3016-1	1
R-f Input Cables, W3001	2
Interconnecting Cable W3046	1
Preamplifier, Model DA-1 (optional equipment)	1

Identification of the equipment described in this manual is found on front-panel nameplates and rear apron patent labels.

I-4. GENERAL DESCRIPTION

Panoramic Indicator, Model SC-8b, is an automatic scanning receiver which permits visual analysis of selected microwave signals within a band up to ten megacycles wide. Each signal within the band being scanned is displayed on a cathode-ray tube screen as a pip or group of pips depending upon the nature of the signal. The amplitudes and positions of these pips along the calibrated horizontal axis are indicative of their signal levels and frequencies respectively. A more functional description of the equipment is presented in the following paragraphs.

a. Panoramic Indicator, Model SC-8b. The Panoramic Indicator, Model SC-8b is designed to operate in conjunction with a receiver or signal source, an external generator, and a mixer. The signal source and the external signal generator are heterodyned in an external mixer to produce the 30-megacycle input center frequency required by the Indicator. This combination forms a microwave spectrum analyzer whose frequency range is limited only by the external generator.

Indicator sweep width is continuously variable from ±5 megacycles to zero. The width may be determined quantitatively from ±50 kilocycles to ±5 megacycles by means of the internal differential markers, supplied as an option. Either wideband observation of a spectrum as large as 10 megacycles or very high resolution analysis of small sections is readily accomplished. Frequency components of the input signal appear dispersed along the linearly calibrated horizontal scale of the crt screen as inverted V-shaped pips. Figure I-1 illustrates a portion of the r-f spectrum. The circle represents the range of pips visible on the Indicator screen. These pips indicate frequencies of signals with respect to a signal at the screen center. Each signal produces its own pip or group of pips which help identify

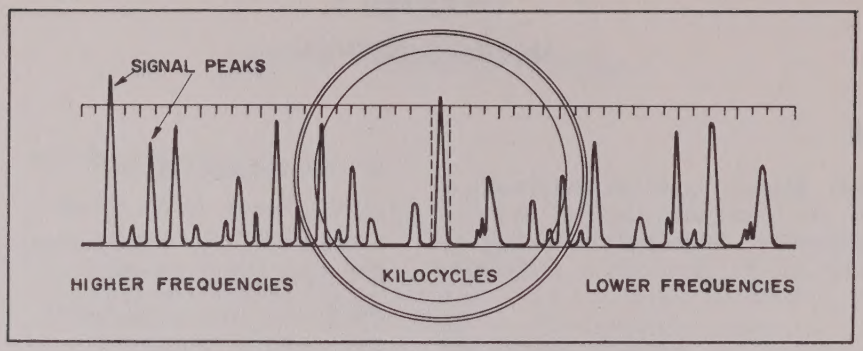


Figure I-1. Presentation of Radio Frequency Spectrum.

and analyze the signal. Their respective amplitudes may be measured by reading the pip heights along any of the three vertical scales; linear (calibrated in 10 divisions), logarithmic (calibrated from +20 db to -20 db in 5 db steps), or the expanded square-law scale. The latter is convenient for determining power points (half-scale deflection being half power), signal locations in pulsed r-f, and critical comparisons between signals or sidebands of similar amplitudes. Sensitivity specifications for the Indicator are listed in Section I-5, ELECTRICAL CHARACTERISTICS. When sensitivities greater than those specified for the standard equipment are required, the use of Preamplifier, Model DA-1, is recommended.

b. Preamplifier, Model DA-1. Panoramic Preamplifier, Model DA-1, supplied as optional equipment, is designed to increase the direct sensitivity of the Indicator, Model SC-8b. Input impedance to the preamplifier is 50 ohms. When used to amplify low level signals, the step attenuator is adjusted to obtain a suitable signal-to-noise level.

c. Signal Presentation. Variable sweep rates and resolutions are provided in the Model SC-8b. Any sweep rate from 1 to 60 sweeps per second may be selected in free-running mode or with synchronization to line or external source. This provision is employed to obtain stationary displays with a very wide range of pulse repetition frequencies, thus showing a time analysis in addition to the spectrum distribution. Pulse skipping is immediately apparent. When analyzing signals with closely spaced sidebands, lower sweep rates are used to take full advantage of the resolving capabilities of the variable i-f filter. At its most selective setting, the i-f section will separate signals 9 kilocycles apart. The RESOLUTION control may be adjusted for optimum visual separation once the sweep width and sweep rate have been selected for a particular measurement.

d. Cathode-Ray Tubes. The standard crt provided with the Indicator is the high-persistence type 5UP7, but any other requested phosphor can be furnished. The Indicator is also available with a camera-mount bezel, flat-face type 5ADP7 (or other phosphor) crt, and edge illumination. Standard 5 inch oscillograph camera hoods may be conveniently attached to this bezel.

e. Basic Operation. The functions described below represent the basic operation of the equipment. Inputs to the Indicator within the 25 to 35 megacycle band are passed by the input filter. The bandpass selectivity of the input filter further discriminates against unwanted products of input conversion. Accepted signals are then amplified and applied to the mixer stage to beat with the swept oscillator frequency of the Indicator.

The swept oscillator is frequency modulated by a sawtooth-driven reactance modulator stage, controlled by the setting of the SWEEP WIDTH control. This oscillator is of push-pull design with excellent frequency stability. It incorporates a feedback network which simultaneously counteracts variations in oscillator amplitude and random frequency modulation. During its frequency excursions, the oscillator successively heterodynes with each of the signals present in the mixer, and produces a series of i-f signals to be amplified in the sharply tuned i-f stages.

The selectivity of the i-f stages is controlled by changing the loading in a dual Q-multiplier. The successive i-f pulses are applied through a diode detector and a d-c coupled video amplifier to the vertical deflection plates of the cathode-ray tube.

Linear amplification of voltage is used for the LIN scale presentation. A logarithmic compression feedback circuit is used for the LOG scale presentation. A square-law detector circuit is used for the EXP presentation. D-c coupling permits examination of c-w signals using very small sweep widths. A capacitive video filter serves to eliminate annoying irregularities in pip shapes when displaying closely spaced signals.

The Indicator is a dual conversion type. The first i-f stage, tuned to 23 megacycles, attenuates any spurious signals caused by the mixing of input signals with harmonics of the sweeping oscillator frequency. The 23 megacycle signal is then applied to the following i-f stage. This stage acts as a converter and produces at its output the second i-f of 650 kilocycles.

NOTE

In equipment bearing serial numbers 23H116 and below (with a 5UP7 crt) or 24J141 and below (with a 5ADP7 crt) the second i-f is 500 kilocycles.

A phantastron-type oscillator provides a linear sawtooth waveform which serves a dual purpose. It is applied simultaneously to the horizontal deflection plates of the crt and to the reactance modulator circuit of the sweeping oscillator. The occurrence rate of the sawtooth can be varied from 1 to 60 cps by varying the SWEEP RATE control located on the front panel. Thus, the horizontal axis of the screen display is effectively a frequency scale.

When an instrument is equipped with differential markers, sweep width markers are produced by two high-capacitance Hartley-type oscillators, tuned by varying a dual air-capacitor. Second-harmonic frequencies are equally spaced above and below the 30 megacycle input center frequency of the Indicator. The front panel differential markers dial indicates this second-harmonic frequency difference, which serves as a calibration for the SWEEP WIDTH control. A convenient by-product of this circuit is the 30-megacycle sum frequency of the fundamentals. When markers are used, the horizontal positioning of the input center frequency indication can be checked by the sum frequency pip.

High inherent stability of the sweeping-oscillator is obtained because of the comparatively low frequency of the Indicator. The oscillator circuitry contains miniature low-power tubes, allowing a d-c rectifier to be used for the heater supply. This provision insures freedom from the common annoyance of hum modulation on the signal displays. Display intensity, focus, and astigmatism are easily adjusted for clear well-defined traces.

I-5. ELECTRICAL CHARACTERISTICS

The following specifications apply to the over-all characteristics of the Indicator:

Sweep Width (Frequency dispersion)	Continuously variable, 0-10 Mc.
Resolution (Frequency separation of two signals of equal amplitudes measured at their intersection 3 db down from peaks)	Continuously variable, 9-80 Kc. (See Figure III-2, Resolution nomograph)
Input Impedance	50 ohms
Sensitivity for full-scale linear deflection.	75μ V
Sweep Rate	1-60 cps, continuously variable Internal sync, external sync, or free-running
Differential Markers	±50 Kc to ±5 Mc, continuously variable
Amplitude Scales (Vertical crt calibration)	Linear, Logarithmic, and Exponential
Visual Display Tube	5UP7, or optional 5ADP7 with edgelit reticle and camera mount bezel
Power Source	115 V AC nominal, 60 cps, single phase. Others on request.
Power Consumption	135 watts

I-6. PHYSICAL CHARACTERISTICS

Physical characteristics of the Indicator units are specified below:

a. Weights

Model SC-8b	28 lbs.
Power Supply, PS-8b	33 lbs.
Preamplifier, Model DA-1	10 lbs.
Constant-Voltage Transformer	24 lbs.
Cabinet, Indicator Section	28 lbs.
Cabinet, Power Supply	12 lbs.
Cabinet, Preamplifier	6 lbs.

b. Dimensions

Model SC-8b in cabinet	See Figure I-2
Model SC-8b in rack mount	See Figure I-3
Model PS-8b in cabinet	See Figure I-4
Model PS-8b in rack mount	See Figure I-5
Model SC-8b and PS-8b in common cabinet	See Figure I-6
Constant Voltage Transformer	See Figure I-7
Model DA-1 in cabinet	See Figure I-8
Model DA-1 in rack mount	See Figure I-9
R-f Cable, W3021	3 feet lg.
Power Cable, W3046	3 feet lg.
R-f Cables (2), W3001	3 feet lg.

I-7. OPERATING CONTROLS

The operating controls of the Indicator, Model SC-8b, and their functions are listed in the following paragraphs. The controls are mounted on the front panel of the Indicator. See Figure I-10 for their identification and location.

THE CENTER FREQ. control (1) serves to maintain or restore the sweeping oscillator at its specified mean frequency, causing a deflection corresponding to the input center frequency to appear at the center of the crt screen. This control may be used as an uncalibrated fine adjustment in conjunction with the external generator. It should not be used at wide sweep widths to bring signals outside the edges of screen calibrations, as this causes the Indicator to operate beyond its bandpass region.

THE RESOLUTION control (2) is used to adjust the i-f bandwidth. Counter-clockwise rotation of this control narrows the width of the second i-f section. As this control is adjusted, there will be some degree of change in the sensitivity of the equipment.

THE AMPLITUDE SCALE control (3) is a three-position rotary switch allowing selection of logarithmic (LOG position), linear (LIN position), or square-law expanded (EXP position) presentations. LOG position is used when the amplitude ratio of frequency components is large. In this position, the calibration dots on the left side of the screen, representing +20 db to -20 db in 5-db separations, are used for measurement. LIN position is used when the amplitude ratio is 20 db (10:1) or less. Calibrated horizontal lines dividing the screen into ten equal sections are used in this position. An associated scale is provided on the right side of the crt screen. EXP position is used primarily to measure and compare small differences between peak levels of signals. Deflection heights of signals on the screen are proportional to power. Full-scale deflection in LIN position equals half-scale deflection in LOG position. A half-scale signal on LOG scale may be increased in amplitude ten times before reaching full-scale deflection. Thus, in LOG position, signals of great amplitude are compressed and viewed without the necessity of adjusting gain controls in associated equipment.

To measure differences in peak levels when in EXP position, adjust a higher peak to full scale and observe the portion of the scale covered by a lower peak. Deflection is proportional to the square of the input voltage. Should the lower

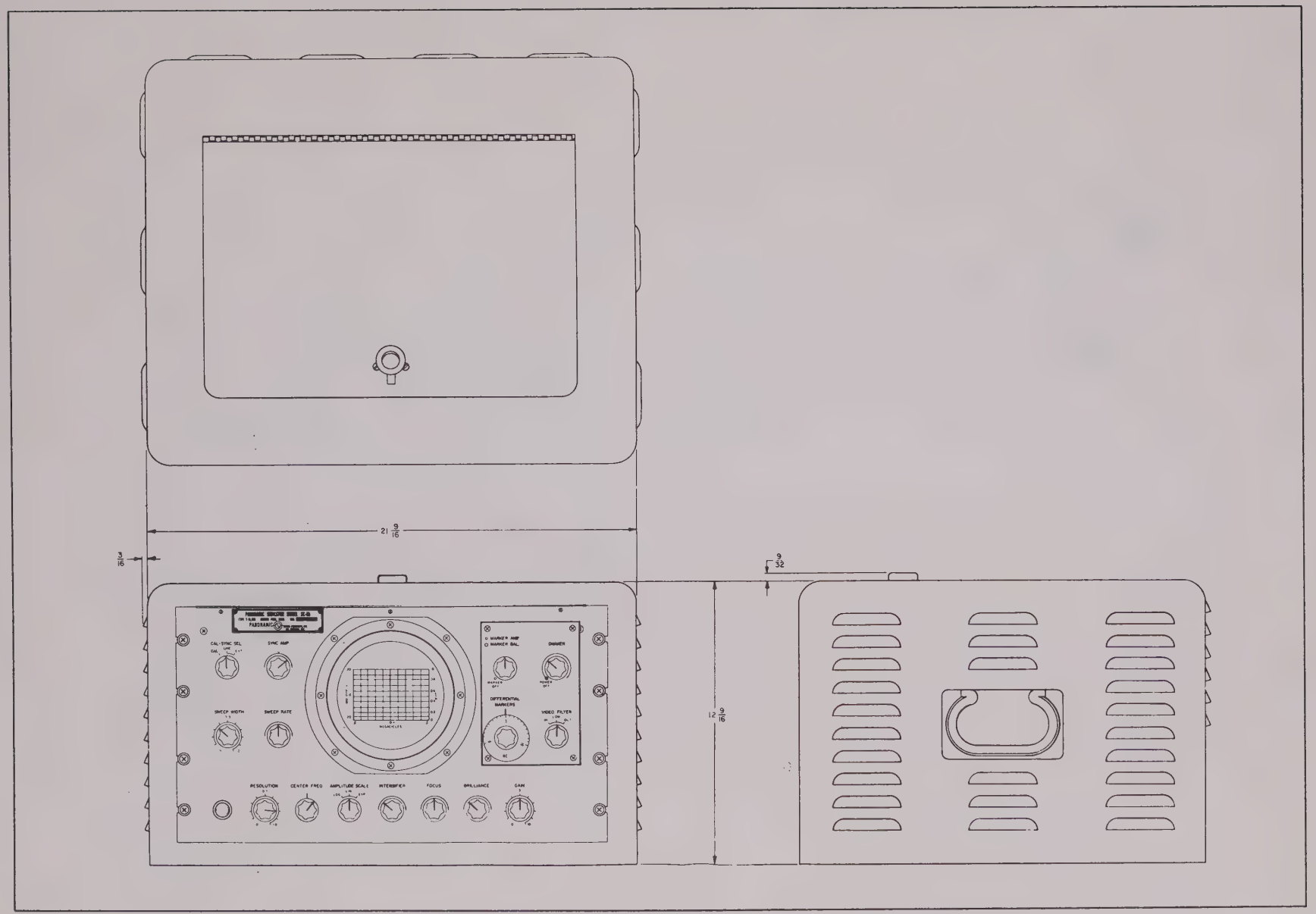


Figure I-2. Outline Dimensional Drawing, Model SC-8b, Cabinet Mounted Style.

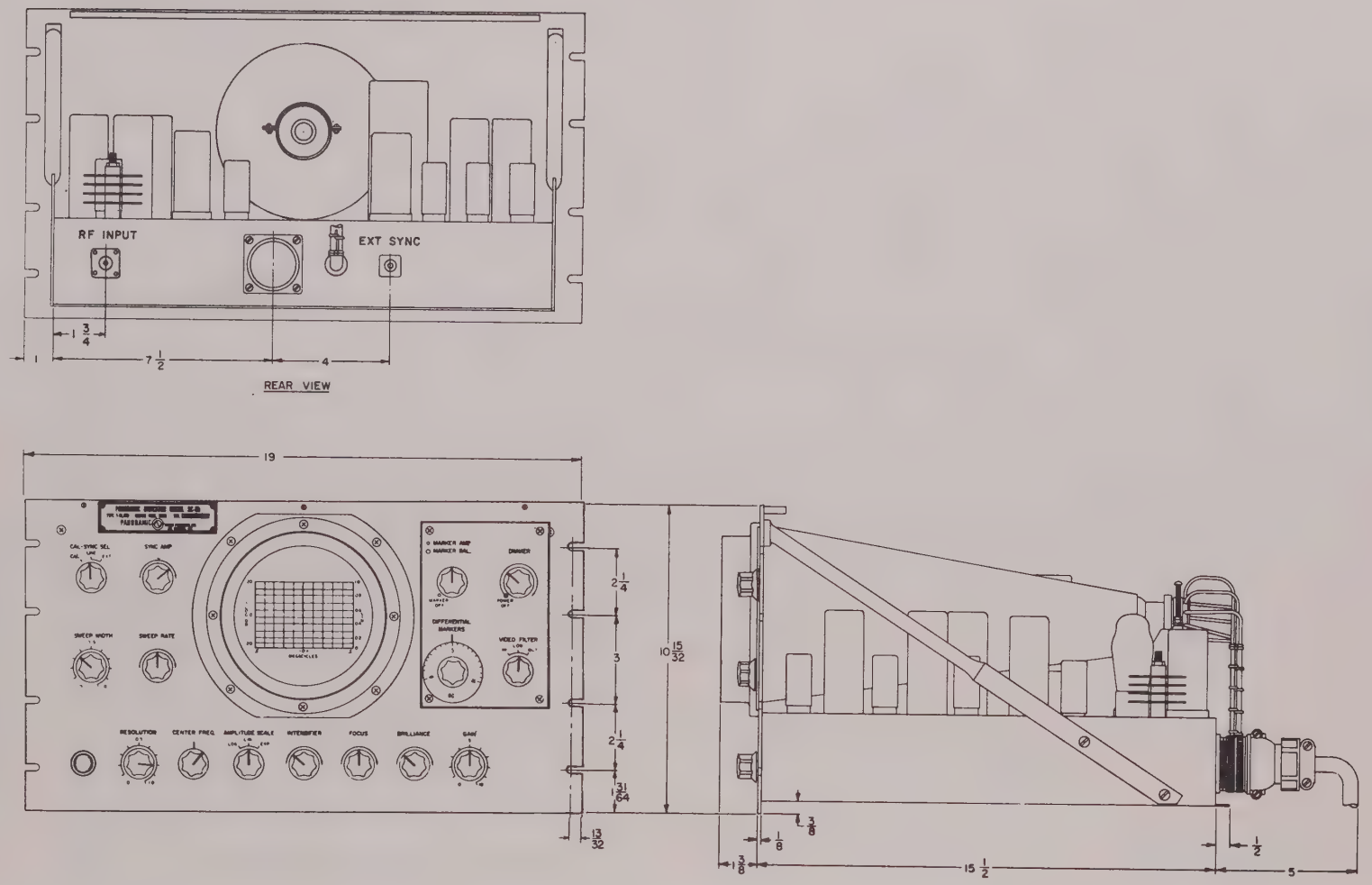


Figure I-3. Outline Dimensional Drawing, Model SC-8b, Rack Mounting Style.

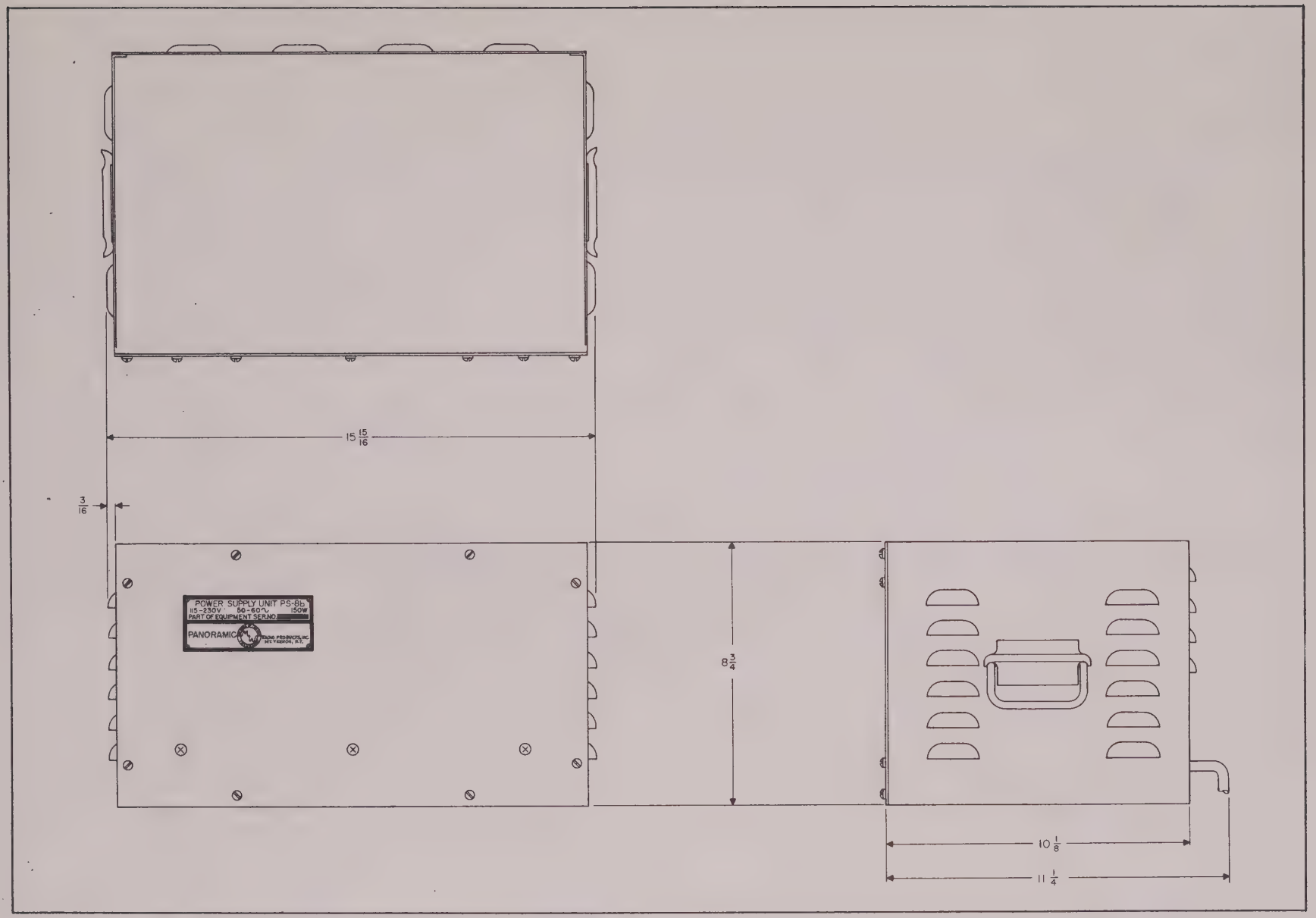


Figure I-4. Outline Dimensional Drawing, Power Supply, Model PS-8b, Cabinet Mounted Style.

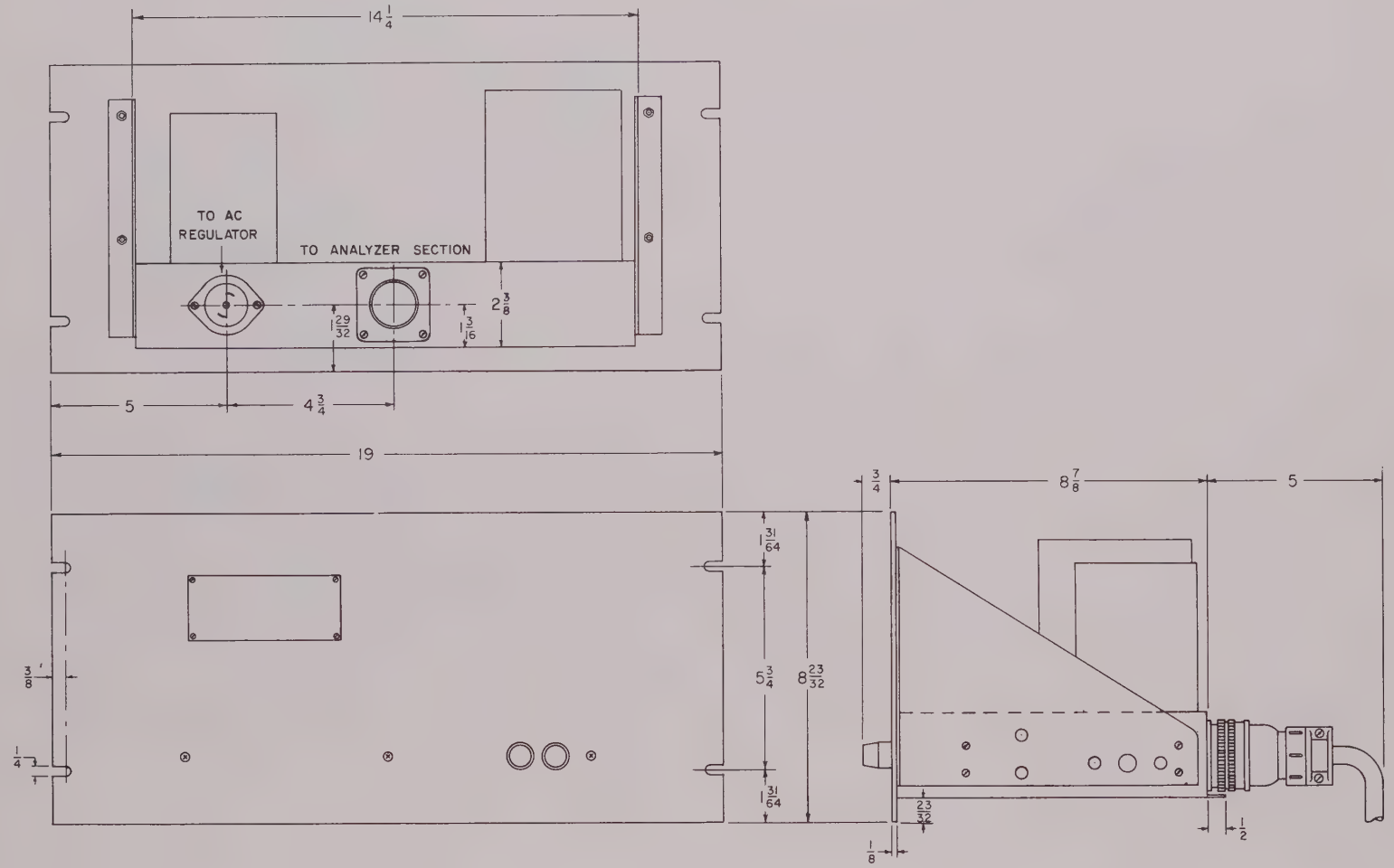


Figure I-5. Outline Dimensional Drawing, Power Supply, Model PS-8b Rack Mounting Style.

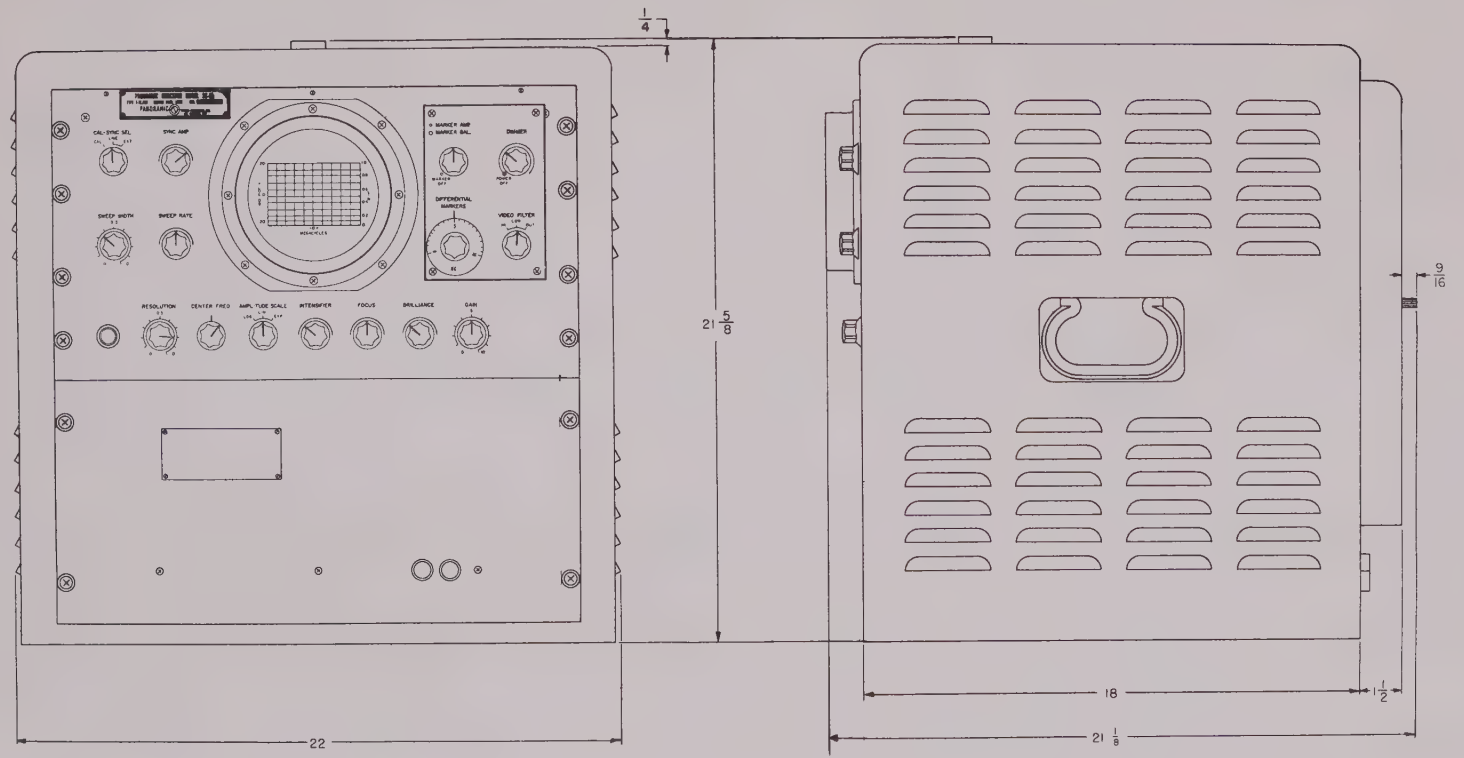


Figure I-6. Outline Dimensional Drawing, Panoramic Indicator, Model SC-8b and Power Supply, Model PS-8b, Mounted in a Common Cabinet.

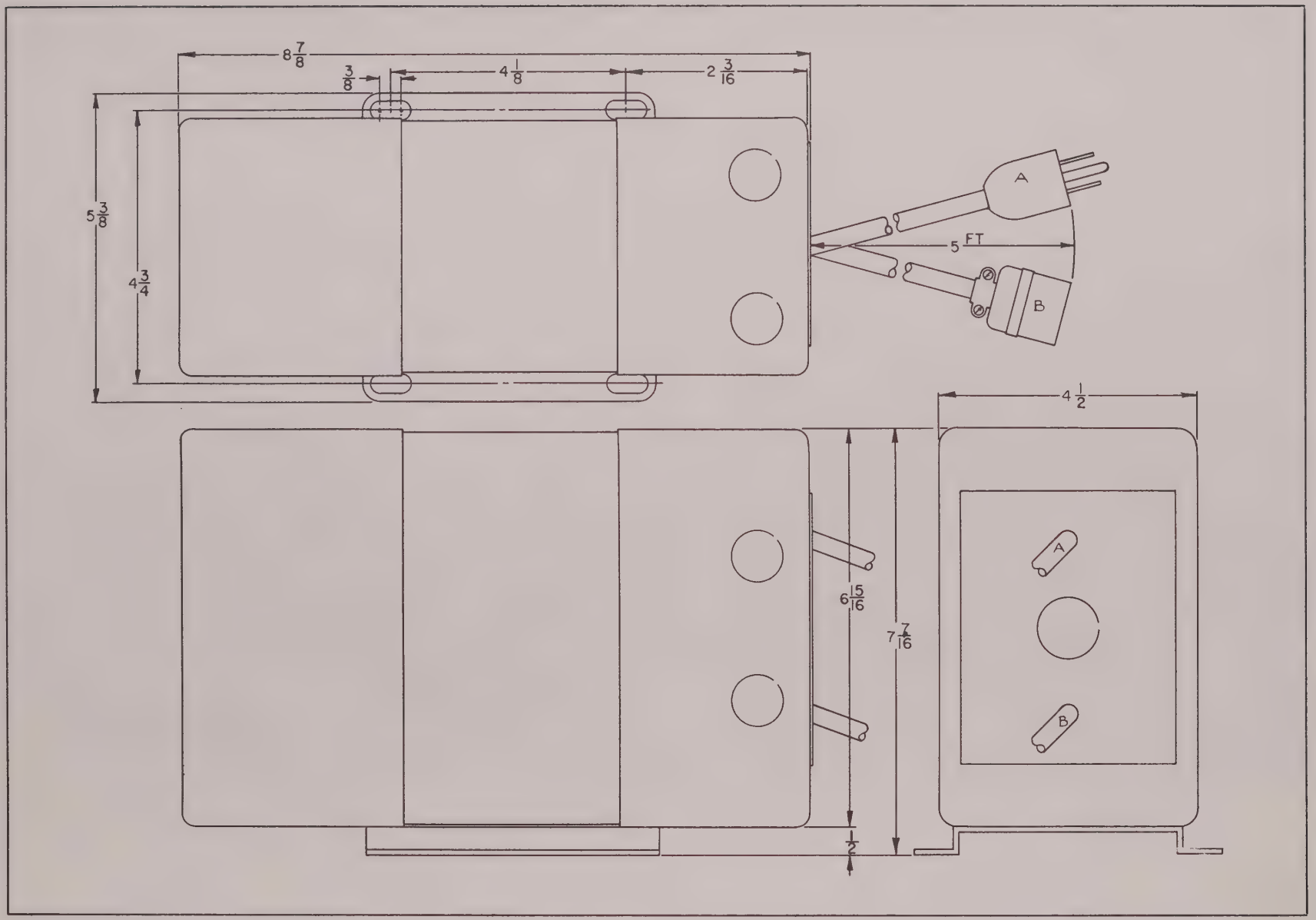


Figure I-7. Outline Dimensional Drawing, Constant-Voltage Transformer

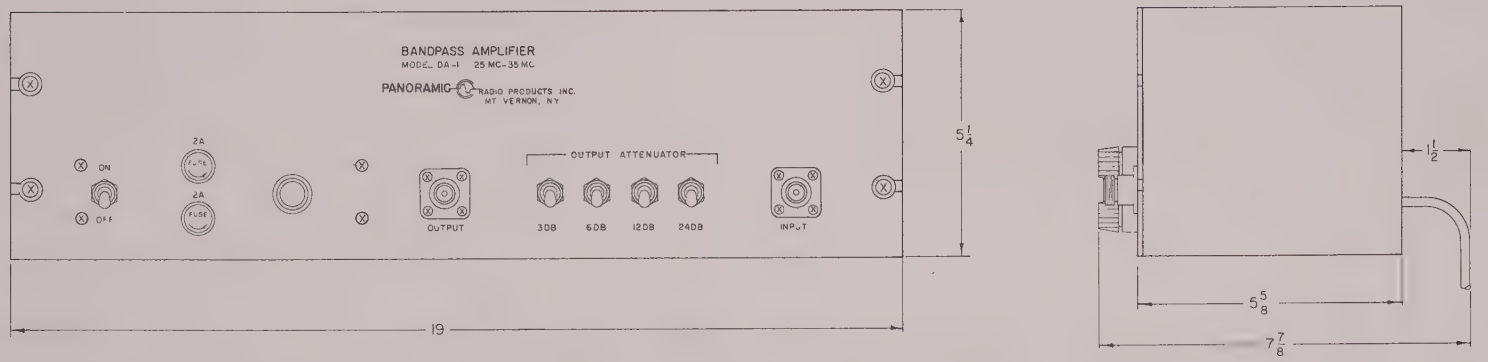


Figure I-8. Outline Dimensional Drawing, Preamplifier, Model DA-1, Cabinet Mounted Style.

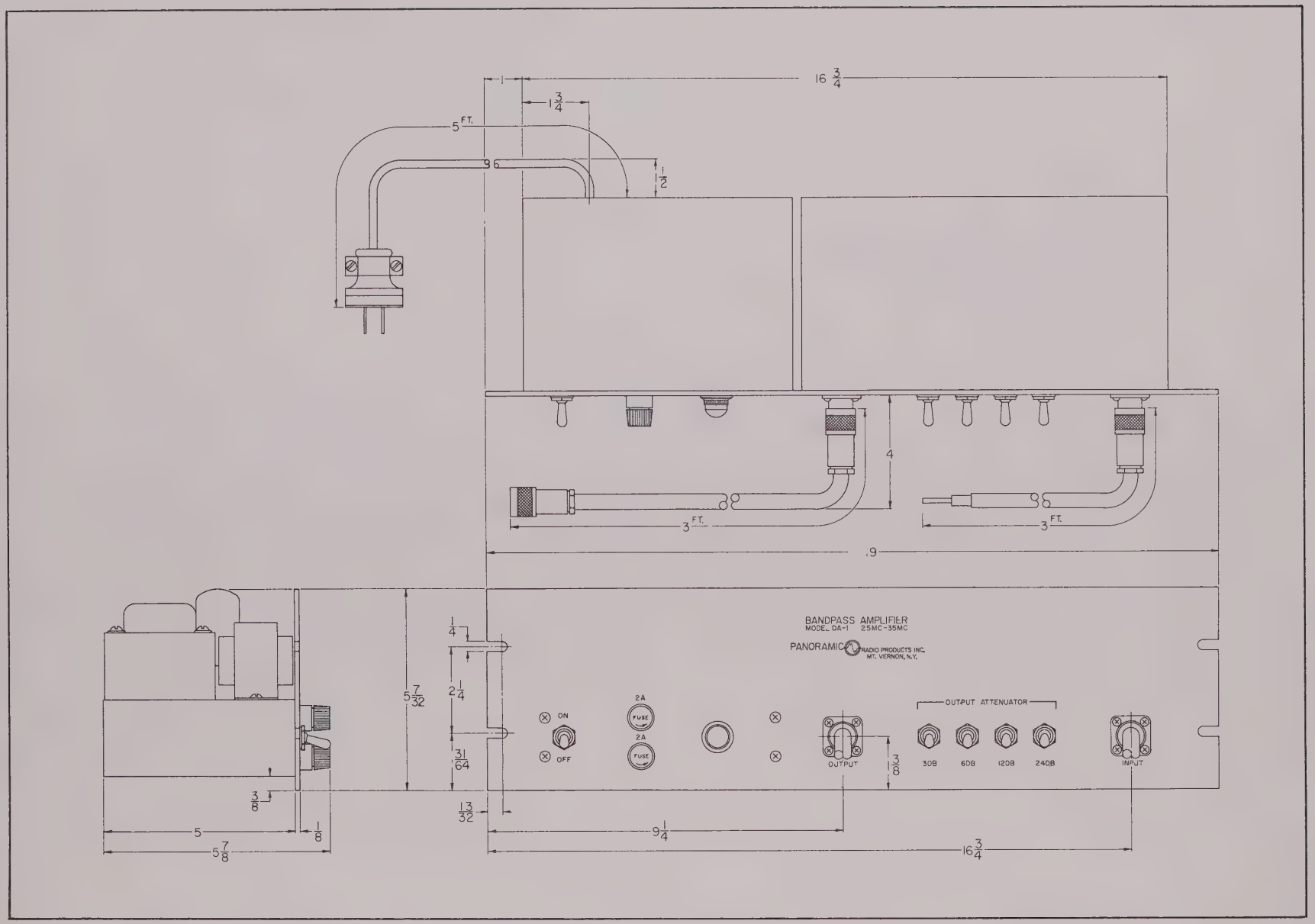


Figure I-9. Outline Dimensional Drawing, Preamplifier, Model DA-1, Rack Mounting Style.

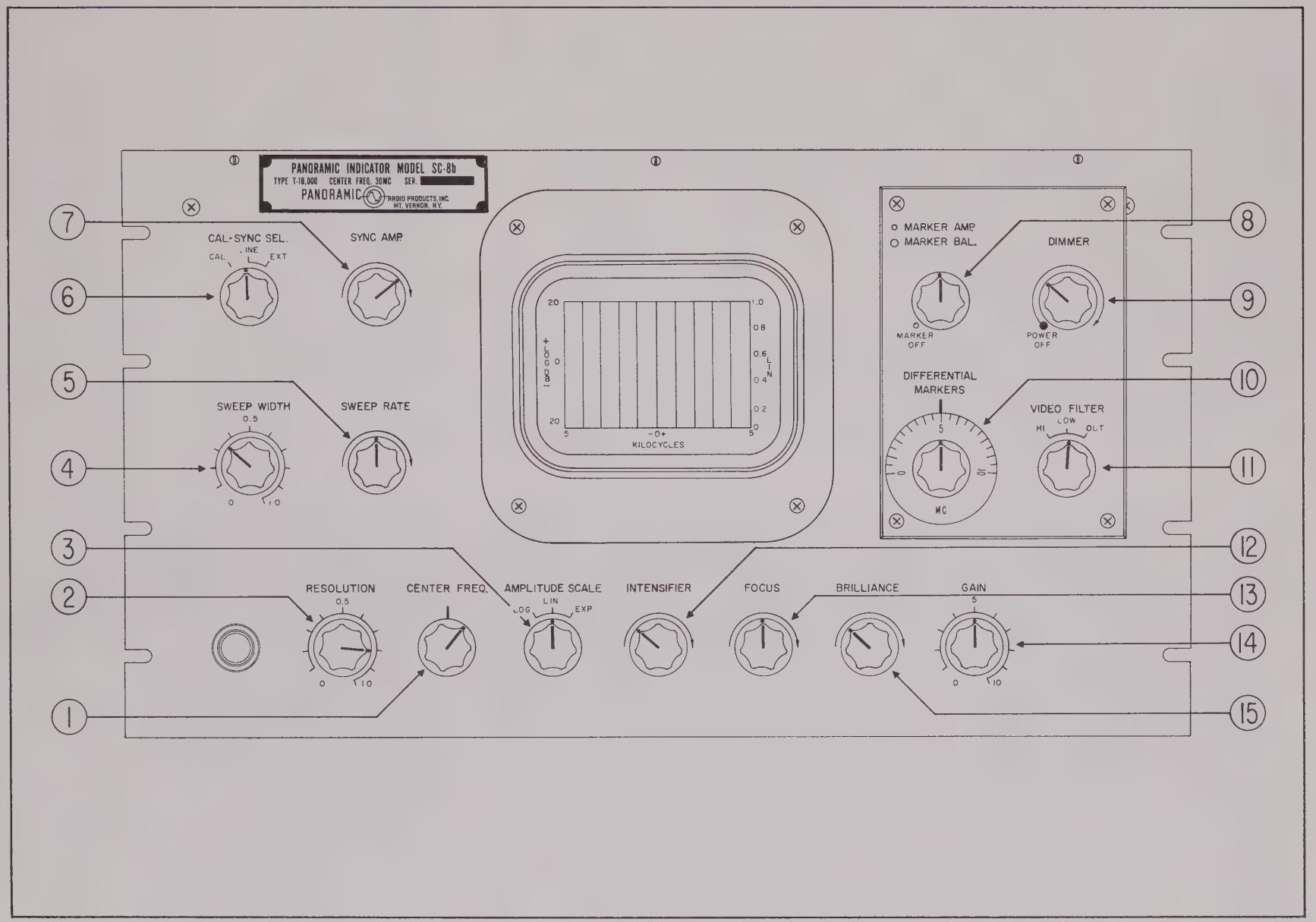


Figure I-10. Front-Panel Controls, Panoramic Indicator, Model SC-8b.

peak measure 1/4 scale, the input voltage ratio between peaks would be 1:$\sqrt{4}$, or 1:2. The circuit is accurate only above 1/4 scale; therefore, it is limited to a 4:1 full-scale power ratio. Because of a-c coupling, the EXP feature functions properly only with narrow pips and/or fast sweeps.

THE SWEEP WIDTH control (4) adjusts the width of the spectrum segment being scanned. When turned completely clockwise, it allows a display of the maximum spectrum width of 10 megacycles. Counterclockwise rotation narrows the bandwidth displayed across the screen. The control markings are approximations. This control, in conjunction with the RESOLUTION control, is useful for separating two or more merged signal deflections.

THE SWEEP RATE control (5) provides continuously adjustable linear sweep rates between 1 cps and 60 cps. Counterclockwise rotation results in reduced sweep rate.

THE CAL-SYNC SEL control (6) is a three-position switch which permits selection of three synchronization methods. In CAL position, calibration of sweep rate is accomplished by injecting power line frequency into the vertical deflection circuit. In LINE position, sweep is synchronized to the power line frequency or an exact submultiple of the line frequency. In EXT position, sweep synchronism is controlled by an external sweep signal source. This signal must be applied to the Ext Sync receptacle on the rear apron of the Indicator chassis.

THE SYNC AMP control (7) adjusts the amplitude of the sweep-synchronizing signal (internal or external). Maximum amplitude occurs at maximum clockwise position.

THE MARKER AMP and MARKER BAL control (8) is a dual concentric control which adjusts marker pip height. When the MARKER AMP control (inner knob) is turned fully counterclockwise, markers are turned off. With clockwise rotation, markers are turned on; further rotation increases the marker pip amplitude. The MARKER BAL (outer knob) is used to compensate for equipment response characteristics and to equalize pip heights.

THE DIMMER control (9), when rotated clockwise, applies power to the Indicator and controls crt scale illumination. On equipment using a type 5ADP7 crt, continuing clockwise rotation of this control increases edge illumination of the screen. On sets with a type 5UP7 crt, the control dims the front panel pilot light. The on-off section of the switch does not control power to the constant-voltage transformer.

THE DIFFERENTIAL MARKERS control (10) is a tuning dial scribed with calibrated indices and numbered at 0, 5, and 10. It is used to indicate the frequency differential between markers. If the marker dial indicates 5, there is a 5 megacycle distance between the two markers (independent of signal frequency). Normal operation requires that the two marker pips be equidistant from the center frequency point; therefore, an indication of 5 on the dial is interpreted as ±2.5 megacycles from the center frequency.

THE VIDEO FILTER control (11) is a three-position switch (HI, LOW, OUT) which provides two degrees of video filtering to suppress unwanted effects such as noise, hum, and spurious beating between adjacent signals. Signal pips will be integrated and slightly shifted when the filter is switched to either HI or LOW position.

THE INTENSIFIER control (12) is turned clockwise when pulsed or noise signals are being observed. These signals will then intensity modulate the crt beam. By turning the BRILLIANCE control until the baseline is barely visible, it is possible to view the intensity modulated signals on the screen in greater contrast.

THE FOCUS control (13) adjusts the sharpness of the crt presentation.

THE GAIN control (14) adjusts the height of the signal deflections displayed on the crt screen. Use low gain whenever possible, to minimize both spurious and noise deflections. Clockwise rotation increases the amplifier gain.

THE BRILLIANCE control (15) varies the intensity of the crt presentation. Clockwise rotation increases the brilliance.

I-8. TUBE COMPLEMENT

Reference designations, types, and functions of the tubes used in this equipment are listed below:

a. Indicator

Circuit Reference Designation	Tube Type	Function
V1	6BQ7A	R-f Amplifier
V2	6BQ7A	R-f Amplifier

Circuit Reference Designation	Tube Type	Function
V3	6J6	Mixer
V4	6AH6	Reactance Tube Modulator
V5	6AH6	Reactance Tube Modulator
V6	6J4	Swept Oscillator
V7	6J4	Swept Oscillator
V8	12AU6	Limiter
V9	6CB6	1st I-f Amplifier
V10	6BE6	2nd I-f Converter
V11	12AT7	2nd I-f Amplifier and Q Multiplier
V12	---	Not Used
V13	6AH6	3rd I-f Amplifier
V14	12AU7	Detector and Vertical Amplifier
V15	12AU7	Intensifier and Vertical Phase Inverter
V16	12AT7	Sync Amplifier
V17	6U8	Horizontal Sweep Generator
V18	12AU7	Horizontal Sweep Amplifier & Phase Inverter
V19	5UP7 or 5ADP7	Cathode-Ray Tube
V20	OD3	Voltage Regulator
V21	6U8	Astigmatism Control & Blanking Amplifier
V22	---	Not Used
V23	12AT7	Exponential Detector and Amplifier
V24	12AT7	Marker Oscillator
V25	12AT7	Marker Oscillator
CR1	16S1B1S1G	Selenium Rectifier Bridge Filament Supply
CR2	1N81A	D-c Restorer
CR960	1N34A	Oscillator Rectifier for Limiter
I-2	47	Keep-Alive for I-10
I-10	NE-16 (Mod.)	Sweep Oscillator Discharge

b. Power Supply, Model PS-8b

V101	5V4G	B+ Rectifier
CR1	V100HF	High Voltage Rectifier
CR2	V100HF	High Voltage Rectifier (used with 5ADP7 crt)

c. Preamplifier, Model DA-1

V1	6J4	Amplifier
V2	6J4	Amplifier
V3	6CB6	Amplifier
V4	6CB6	Amplifier
V5	6CB6	Amplifier
V6	6J4	Cathode Follower
V7	5Y3	Rectifier
V8	OA2	Voltage Regulator

I-9. TERMS AND DEFINITIONS

The terms listed below are used throughout this manual, and are defined for a better understanding of Indicator operation.

a. Panoramic Reception is simultaneous reception of signals contained in a continuous portion of the frequency spectrum. These signals are received at fixed, rapid intervals and appear to be continuous when viewed on a cathode-ray tube.

b. Sweep Width is the band observed by panoramic reception which corresponds to the range of the oscillator sweep in panoramic equipment.

c. Baseline is the line produced by the electron beam sweeping horizontally across the cathode-ray tube.

d. Frequency Sweep Axis is a calibrated line scribed on the screen to indicate the frequencies on either side of the center frequency.

e. Center Frequency is the frequency appearing over the zero on the frequency sweep axis with the SWEEP WIDTH control set for zero sweep.

f. Resolution is the frequency difference between the peaks of two signals of equal amplitude when they merge at a point 3 db down from peak amplitude. This frequency difference is measured along the frequency sweep axis. Smaller differences indicate better resolutions.

g. Sweep Rate is the number of times per second the electron beam sweeps horizontally across the cathode-ray tube.

h. Deflection Amplitude is the height of signal deflection measured from baseline to peak.

i. Sweeping Oscillator is the reactance oscillator used to modulate the mixer circuit to obtain panoramic reception.

j. Sweep Generator is the sawtooth generator used for horizontal sweep of the crt beam and for modulation of the reactance oscillator.

k. Markers are calibrated beat oscillations injected into the 1st i-f amplifier and displayed on the crt screen to estimate frequency separation of signals.

l. Line Size denotes the horizontal distance covered by the baseline. It is synonymous with horizontal gain.

CHAPTER II
INSTALLATION

II-1. INITIAL INSPECTION

This instrument has been tested and calibrated before shipment. Only minor preparations are required to put the instrument in operational condition. The equipment is shipped with all tubes and crystals installed. Check that all such components are properly seated in their sockets.

If damage to the case is evident when delivery is made, have the person making the delivery note the damage on all delivery receipt copies and sign the notation. Most public carriers do not recognize claims for concealed damage if such damage is not reported within fifteen days after delivery. All shipping containers should be opened and equipment inspected before fifteen days elapse. If damage is found, whether concealed or obvious when delivered, call or write the carrier and ask that an inspection be made by their agent. Although the carrier is liable for any damage in the shipment, Panoramic Radio Products, Inc. will assist in describing and providing for repair or replacement of damaged items.

II-2. MOUNTING

The equipment should be located in an area where sufficient ventilation is available and ambient light is not excessively bright. Do not use the BRILLIANCE control to compensate for light falling on the crt screen. Locate the constant-voltage transformer as far as possible from the Indicator unit to minimize hum pickup.

The constant-voltage transformer should be mounted with the nameplate right side up. This will place the ventilated compartment downward, providing cooler capacitor operation. However, the unit will perform satisfactorily if horizontal mounting is unavoidable.

The constant-voltage transformer depends upon natural draft air circulation for adequate cooling. It should not be mounted in confined or enclosed spaces unless special provisions have been made for ventilation. In operation, a temperature rise will occur whether or not the transformer is serving a load. Therefore, it is recommended that provisions be made for a line switch to disconnect power to the constant-voltage transformer when the unit is inoperative.

II-3. EQUIPMENT CABLING

Before operating the equipment, check the power supply and terminations of the interconnecting cables as specified in the following paragraphs.

a. Power Supply. The Model PS-8b requires 118 volts, 50-60 cycles for proper operation. In order to deliver a stable supply of this power requirement, a constant-voltage transformer is supplied and must be used as the power supply input at all times.

CAUTION

1. Do not use the constant-voltage transformer to supply line power to auxiliary or additional equipment together with the Panoramic equipment.
2. For satisfactory operation, the constant-voltage transformer must be used within the input voltage and frequency limits specified on its nameplate.

A constant-voltage transformer, operating within one of the four following voltage-frequency combinations, is supplied in accordance with the customer's purchase order request:

	Input Voltage	Frequency
1.	95 - 130 V	60 cps
2.	95 - 130 V	50 cps
3.	195 - 230 V	60 cps
4.	195 - 230 V	50 cps

b. Cable Connections. Table II-1 below lists the cables supplied with the equipment and their interconnecting points. See Figure II-1 for connector identification.

c. External Oscillator Frequency. Although the frequency of the external heterodyning oscillator or signal generator which is connected to one of the r-f input connectors may be either 30 mc above or 30 mc below the test signal frequency, use the following rules in choosing this frequency: If possible, avoid using a frequency within the 25 to 35 mc input range of the Indicator, or frequencies whose harmonics fall within that range. For all test signals with a frequency range up to 67 mc, use a signal generator frequency 30 mc above the test signal frequency. For test-signal frequencies between 67 and 150 mc, a signal generator frequency above the test-signal frequency is preferable but not essential. This will avoid the presence of image frequencies.

Table II-1. Cabling Connections

Cable	From	To
14-wire interconnecting power cable, W3046	J10, rear of Indicator chassis	J2, rear of power supply chassis
3-wire power cable w/ female plug	Constant-voltage transformer	J1, rear of power supply chassis
3-wire power cable w/ male plug	Constant-voltage transformer	Appropraite a-c power source
Coaxial cable w/1 type N connector	J101, rear of Indicator chassis	Output of external mixer

If the signals to be examined lie between 25 and 35 mc, the r-f cable supplied with the equipment is used to connect the r-f input connector on the rear of the chassis to the signal source. If the frequencies to be observed are above or below the 25-35 mc range, then a suitable external mixer and external oscillator or signal generator that provides the necessary frequency range will be needed. The signal under test is fed to the mixer input, as is the output of the external signal generator. The output of the mixer is then connected to the r-f input connector at the rear of the chassis.

The mixer must have the following characteristics:

(1) Its output must be tuned from 25 to 35 mc.

(2) If the Panoramic Bandpass Amplifier, Model DA-1, is used, the mixer should have a low noise figure.

(3) The output should be able to be terminated by the 50-ohm input impedance of the Panoramic Indicator.

For frequencies above 150 mc, the signal generator frequency may be 30 Mc above or below the test signal frequency.

NOTE

The signal generator frequency can be recognized as being below the test signal frequency if the pip moves from the left (-) to the right (+) as the generator frequency is increased. When the generator frequency is above the test signal frequency a pip will move from (right) (+) to left (-) as the generator frequency is increased. When the frequency of the external oscillator is above the test signals, the plus and minus signs on the screen apply; that is, signals on the plus (+) side are higher in frequency than the center signal, while those on the minus (-) side are lower. If the oscillator frequency is below the test signal, the signs are reversed. Note that when 25 - 35 mc. is fed directly into the input, the screen signs are reversed.

II-4. PRELIMINARY ADJUSTMENTS AND CHECKS

A logical sequence of adjustments and checks of front panel and chassis controls is described in the following paragraphs. Should any of the checks fail to produce the indicated results, refer to CHAPTER V - SERVICE AND MAINTENANCE.

a. Application of Power. Turn power on with the DIMMER control. The pilot light should go on immediately. If the equipment is supplied with a type 5ADP7 crt, clockwise rotation of the DIMMER control will increase the brightness of the crt screen edge lighting. If a type 5UP7 crt is provided, clockwise rotation of the DIMMER control will dim the pilot light.

Set the BRILLIANCE control between one-half and two-thirds of the maximum clockwise position. The baseline trace should appear within five minutes.

b. Indicator Adjustments and Checks. Adjustments and checks for the Indicator are listed

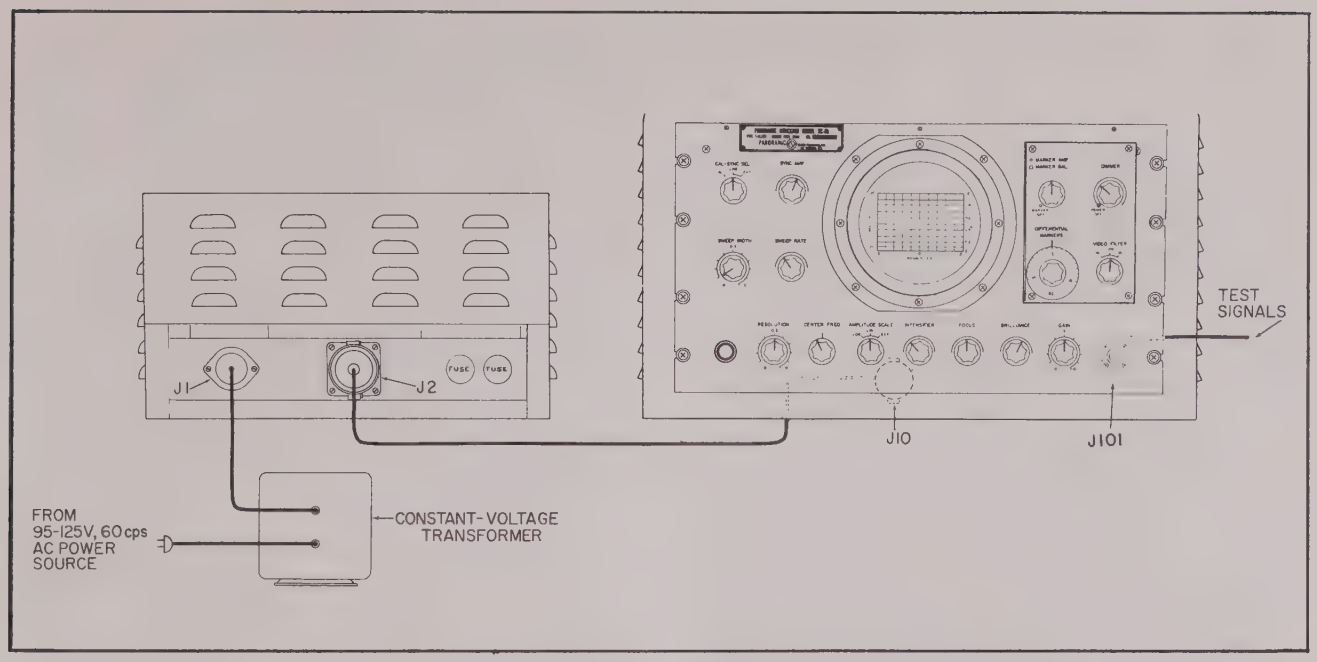


Figure II-1. Cable Connections.

below. To perform these checks, disconnect the r-f cable from J101 and apply a calibrated 30 mc signal to this connector.

1. FOCUS. Turn the FOCUS control through its entire range. The trace should change from blurred to sharp to blurred. Set the control at the sharp trace position for optimum viewing.

2. BRILLIANCE. Turn the BRILLIANCE control through its entire range. The intensity of the baseline should vary; at full counterclockwise position it should be off, at full clockwise position it should be at its brightest. Normally, varying this control will also vary the focus. Adjust both controls to obtain a sharp, bright trace.

3. GAIN. Clockwise rotation of the GAIN control increases the gain of the amplifiers. To measure the gain, turn the CAL-SYNC-SEL switch to LINE, turn the RESOLUTION and SWEEPWIDTH controls fully clockwise, and set the AMPLITUDE SCALE control to LIN. Inject a calibrated 30-mc signal of 75 microvolts into the input jack J101 and turn the GAIN control fully clockwise. The signal pip should reach full-scale height.

4. INTENSIFIER. Set the INTENSIFIER control at its maximum counterclockwise position. Turn the GAIN, RESOLUTION, and SWEEP-WIDTH controls fully clockwise. Noise peaks may appear on the screen. Rotate the GAIN control counterclockwise until the noise level deflection is 1/4 inch. Adjust the input signal for full-scale deflection. Turn the BRILLIANCE control counterclockwise until the deflections almost fade out. Turn the INTENSIFIER control clockwise. The noise lines and signals will become brighter but the baseline will not be present.

5. SWEEP RATE and SYNC AMP. Set the CAL-SYNC SEL control to CAL. If necessary, reduce the amplitude of the signal. Turn the SYNC AMP control fully counterclockwise and the SWEEP RATE control fully clockwise. As the SWEEP RATE control is slowly turned counterclockwise one cycle of the line frequency should appear. Slowly turn the SYNC AMP control until the display is steadied. If the line frequency is 60 cps, the one-cycle presentation will indicate a 60 cps sweep. Continue turning the SWEEP RATE control counterclockwise for indications of 30 cps sweeps (2-cycle presentation), 20 cps sweeps (3-cycle presentation), and 15 cps sweeps (4-cycle presentation). The sweep rate at any position is equal to 60 cps divided by the number of cycles visible. A one-second sweep is reached near the maximum counterclockwise position of the SWEEP RATE control. At low rates, it is easier to count the sweeps by using a stop watch.

6. CENTER FREQ. Set the center frequency signal near the approximate center of the screen. Turn the SWEEPWIDTH control fully counterclockwise. Adjust the CENTER FREQ control for maximum vertical deflection. Turn the SWEEPWIDTH control to maximum. The pip

should be located exactly at the center of the baseline.

7. SWEEPWIDTH. Set the front-panel controls as outlined for CENTER FREQ check. With the SWEEPWIDTH control completely clockwise, vary the frequency of the input signal between 25 and 35 mc. When the upper and lower limit frequencies are applied, corresponding deflections will appear within one-half division of the horizontal calibration extremities scribed on the frequency sweep axis, indicating that the scanning width is within specifications.

8. RESOLUTION. Set the front-panel controls as outlined for the CENTER FREQ check. Apply a 30 mc signal and adjust the GAIN control for full-scale deflection. Gradually reduce the scanning width using the SWEEPWIDTH control until the pip base covers approximately one-third of the screen. The pip width should decrease when the RESOLUTION control is turned counterclockwise, and a change in pip height may be noticed. Rotation through the full range of the RESOLUTION control may result in a major change in pip height. Small convolutions or ringing will appear on the trailing edge of the pip. Optimum resolution occurs when the first convolution beyond the apex of the pip dips into the baseline. (See Figure III-1).

9. AMPLITUDE SCALE. Set the front-panel controls as outlined for the CENTER FREQ check. Apply a 30 mc signal and adjust the pip height for full-scale deflection. Switch to LOG position. The deflection should reduce to half-scale (0 db). Increase the signal input to ten times its original strength; the deflection should rise to full scale (+20 db).

10. CAL-SYNC SEL. For CAL position see step 5. In LINE position, note that an end of the trace line is visible. Set the SWEEP RATE control for approximately 30 cps. Set the SYNC AMP control at its maximum counterclockwise position. The end of the trace line will appear to jitter back and forth. Slowly advance the SYNC AMP control. At about one-quarter rotation, the trace line will remain stationary.

In the EXT position apply 60 cps from the secondary of a filament transformer (or from any other available 5-15 volt supply at the line frequency) to the Ext Sync jack on the rear apron of the Indicator chassis. Set the SYNC AMP control to its maximum counterclockwise position. The end of the trace line will appear to jitter back and forth. Slowly advance the SYNC AMP control. At about one-quarter rotation, the trace line will remain stationary.

11. VIDEO FILTER. When the VIDEO FILTER is switched to LOW position, noise on the screen is filtered, and signal pips are integrated and shifted slightly. Greater effects are noticed with the switch in the HIGH position. The switch position (LOW or HIGH) is selected to give the clearest picture with the minimum loss of amplitude. Sweep rate will have some effect on the resultant picture. Fast sweep rates will degrade the picture beyond use.

12. MARKER AMP. Set the front-panel controls as outlined in the CENTER FREQ. check, and set the SWEEPWIDTH control to 1.0. Clockwise rotation of the MARKER AMP control will increase the amplitude of the markers. To avoid spurious marker pips, adjust the control for a pip height of full-scale on LIN and no more than half-scale on LOG. When the equipment is in use, the MARKER AMP control is set at the discretion of the operator.

13. MARKER BALANCE. Set the DIFFERENTIAL MARKERS dial to 5. Two side marker pips and one center marker pip will appear on the baseline. Rotate the MARKER BAL control through its range. When the side marker pips are at equal amplitudes, the MARKER BAL control is set properly.

14. DIFFERENTIAL MARKERS. When the DIFFERENTIAL MARKERS dial is on 0 position, one marker pip will appear at the center of the baseline. As the dial is turned toward 10, two pips will separate from the center and move toward the ends of the baseline. A smaller pip will remain stationary at the center mark. When the DIFFERENTIAL MARKERS dial reaches 10, the two side marker pips will reach the ends of the screen calibration. These points should coincide with the SWEEPWIDTH checks made in step 10. Return the dial to 0. The two side markers will converge on the center marker pip and a zero beat indication will result.

CHAPTER III
OPERATION

III-1. GENERAL OPERATION

The general operation of the Panoramic Indicator, Model SC-8b, is described in this chapter. Before operating the equipment, be sure the adjustments and checks listed in Section II-4 have been completed. To operate the equipment, proceed as follows:

a. Turn power on with the DIMMER control. Allow five minutes warmup time for the baseline to appear on the screen.

b. When baseline appears, set the front panel controls to the following positions:

Control	Position
CENTER FREQ	on vertical marker
SWEEP WIDTH	fully clockwise
RESOLUTION	fully clockwise
BRILLIANCE	to desired brightness
INTENSIFIER	fully counterclockwise
FOCUS	to sharpest trace
AMPLITUDE SCALE	LIN
GAIN	approximately 3/4 maximum
SWEEP RATE	30 cycles
VIDEO FILTER	OUT
CAL-SYNC SEL	LINE
SYNC AMP	clockwise until sweep is locked in

c. Apply the signal to the input jack J101 of the Indicator. If the Preamplifier, Model DA-1, is being used, apply the signal to the INPUT jack on the front panel of the DA-1, and connect its OUTPUT jack to the input jack J101 of the Indicator. If an external mixer and signal generator are being used, feed the input signal to the appropriate point of the mixer, and connect the mixer output either to the Indicator input jack J101 or to the INPUT jack of the Model DA-1 Preamplifier.

d. Operate the Indicator at maximum gain. When on signal, the GAIN control can be rotated counterclockwise to reduce the amplitude. The four OUTPUT ATTENUATOR switches on the Model DA-1 should be kept in the up positions. To attenuate the input signal by a given amount of db, throw the appropriate switch to the down position. Two or more switches in the down position provide attenuation equal to the sum of their labelled db; thus, if the 3 DB, 6 DB, and 12 DB switches are down, 21 DB of attenuation is provided.

e. To determine the absolute frequencies precisely, an absorption-type wavemeter should be inserted between the signal source and the signal input. Tune the wavemeter through its range. When the signal pip disappears from the screen or decreases to a minimum, the wavemeter indicates the signal frequency.

III-2. RELATIVE AMPLITUDE MEASUREMENTS

Relative heights of pip deflections on the crt screen are proportional to relative amplitudes of frequency components being analyzed within the limits of the flatness of response. To observe signals of comparative amplitude, set the AMPLITUDE SCALE control to LIN position. The LIN scale of the crt screen is calibrated into ten divisions, with indices on the right side of the screen.

Examination of signals of wide divergence in amplitude will require the LOG setting of the scale control. In this position, the calibration range is from +20 db to -20 db, in 5-db steps as indicated by the calibration dots on the left side of the screen. Circuit time constants do not allow the LOG feature to function properly with narrow pulses. In EXP position, pip deflection height is proportional to the square of the voltage (power) of the frequency component. Thus, differences in amplitude will be accented for closer evaluation. This accentuation will improve the signal-to-noise ratio on the screen. Additional signal-to-noise ratio improvement can be obtained with the VIDEO FILTER control. The EXP feature is accurate only when comparing pip heights above 1/4 scale deflection.

III-3. OPERATION WITH DIFFERENTIAL MARKERS

The following procedure describes the operation of equipment provided with differential markers:

a. Engage the marker circuit by turning the MARKER AMP control clockwise. Continue the clockwise rotation until the marker pips are half- to full-scale height. If operated for full-scale on log amplitude, spurious pips will appear;

therefore, it is important not to exceed half scale when set to LOG position.

b. Adjust the MARKER BAL control to equalize the heights of the marker pips.

c. The distance between the two markers is varied with the DIFFERENTIAL MARKERS control, and the sweep width is read directly from the calibrated dial. If the frequency separation of the markers is greater than the sweep width, marker pips will not appear on the screen. Increasing the sweep width will return the marker pips.

III-4. NARROW-BAND ANALYSIS

At full sweep width, deflections of test signals, or carriers and sidebands having small frequency differences, tend to merge. These deflections may be separated (resolved) by reducing the sweep width, or by narrowing the i-f bandwidth, as listed below.

a. Set the RESOLUTION control completely clockwise for broadest i-f bandwidth.

b. Tune the desired band of signals to the center of the screen.

c. Spread the band of signals across the screen by turning the SWEEP WIDTH control counterclockwise. Note that at reduced sweep width each screen calibration mark represents a frequency separation of one-tenth sweep width. Keep the band centered with the CENTER FREQ control.

d. Turn the RESOLUTION control counterclockwise until individual signals are clearly resolved. If signals do not resolve, a slower sweep rate must be used. Best resolution can be recognized by the nature of the ringing pulses appearing on the trailing edge of the signal pip. See Figure III-1. Ringing can be seen more easily with the VIDEO FILTER control in the OUT position. Rotation of the RESOLUTION control affects pip amplitude. Reset amplitude with GAIN control. Rotating the RESOLUTION control past the point where best resolution is reached will decrease resolving power and greatly reduce sensitivity.

The waveforms of Figure III-1 indicate the progressive variations in pip shapes caused by rotation of the RESOLUTION control. In (a) and (b), i-f bandwidth is broad. As the control is rotated, ringing of the signal occurs, as shown in (c). The extent of ringing in (d) shows the best possible resolution. At this point, the notch between the signal pip and nearest ringing pip extends into the baseline. As the i-f bandwidth is narrowed further, excessive ringing widens the signal pip, decreases pip amplitude, and ef-

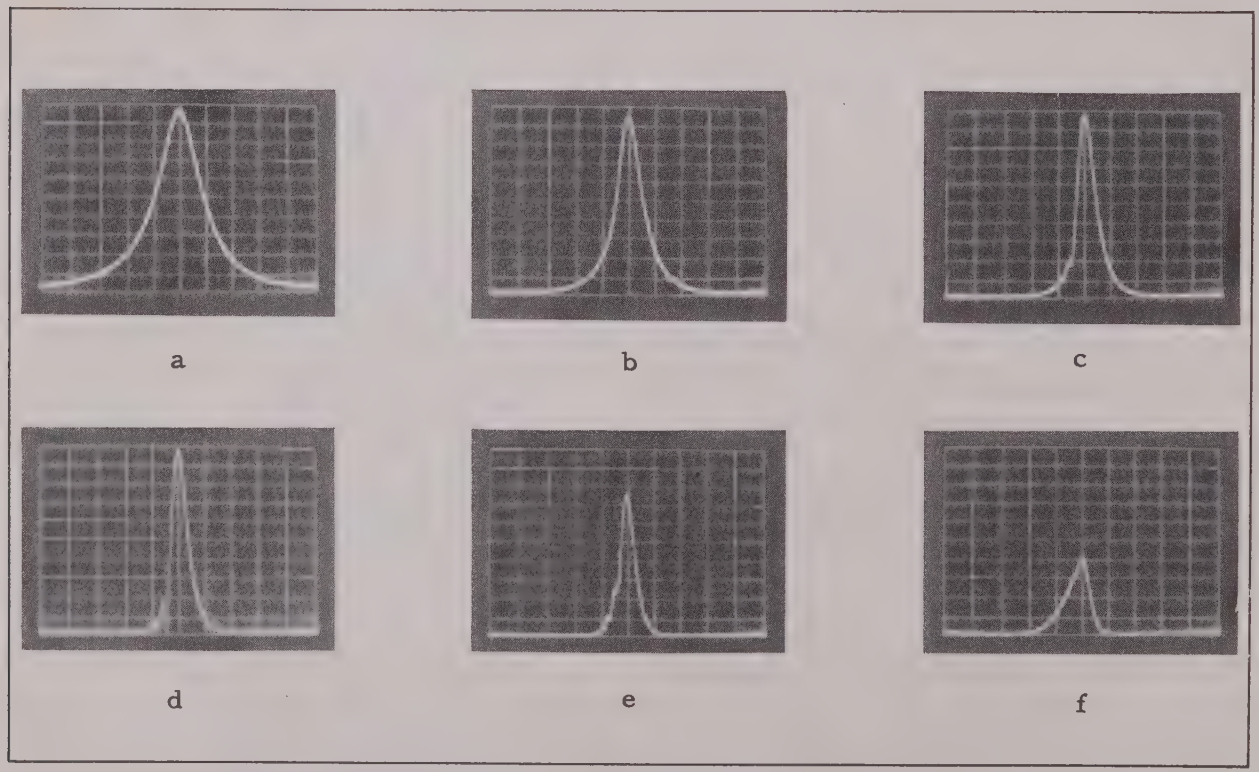
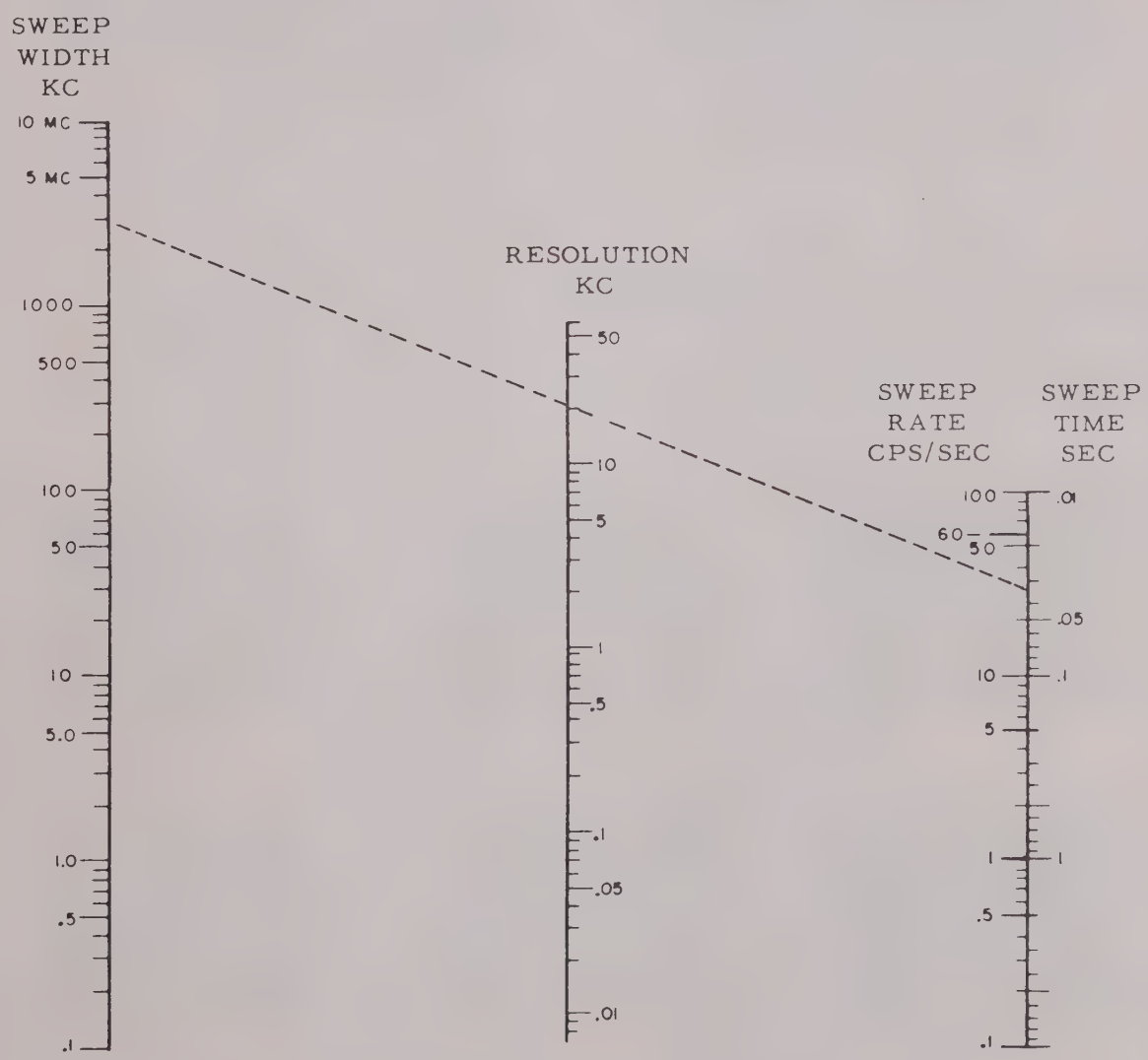


Figure III-1. Ringing as an Indication of Optimum Resolution

fectively reduces the resolving power. Further rotation of the RESOLUTION control causes a reduction in amplitude and remerging of pips as shown in (e) and (f).

Figure III-2 is a nomograph for determining the relationship between resolution and sweep width at sweep rates of 0.1 to 100 cps. It is used for determining the best possible resolution for any given combination of sweep width and sweep rate. The figures given in the nomograph apply only within the limits specified for sweep width, sweep rates and resolution range in section I-5 - ELECTRICAL CHARACTERISTICS.

For a given setting of the SWEEP WIDTH control, and for any one sweep rate, there is a setting of the RESOLUTION control which will



NOTE

Portions of this nomograph which are usable for the Indicator covered by this Instruction Manual are listed under maximum sweep width, sweep rates and resolution in Section I-5. ELECTRICAL CHARACTERISTICS.

Figure III-2. Resolution Nomograph.

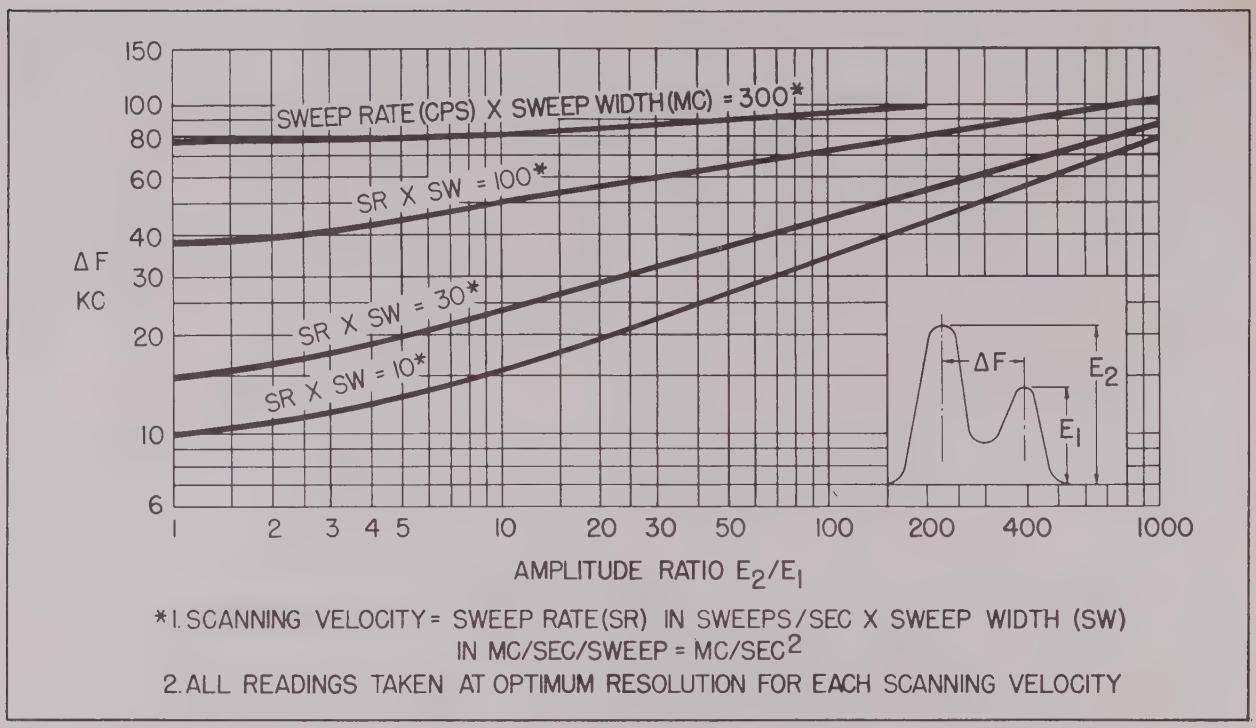


Figure III-3. Minimum Frequency Separation F (KC) Required to Measure Amplitude Ratios E_2/E_1.

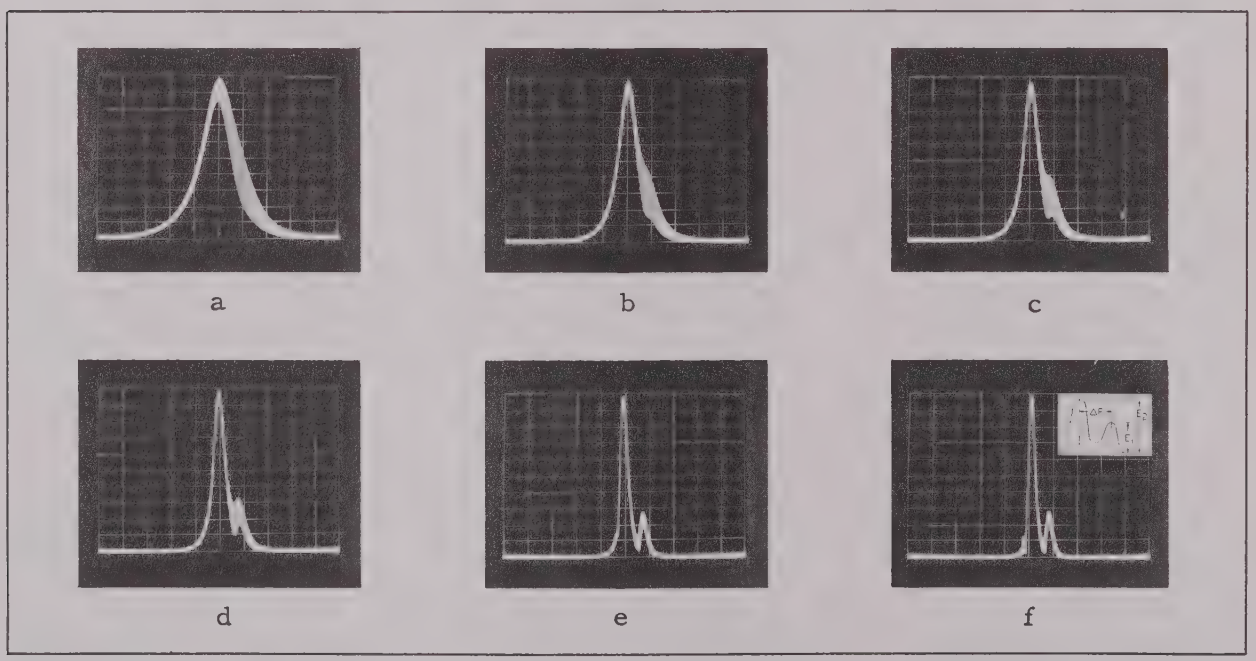


Figure III-4. Resolution of Signals of Unequal Amplitude.

produce the best resolution. The following example illustrates how the resolution nomograph is used.

Assume that two signals of equal amplitude, 20 kilocycles apart, are to be observed. At a sweep rate of 30 cps, a sweep width of 3 megacycles or less must be used to resolve 20 kilocycles, as indicated by the dashed line.

If a signal of small amplitude is close in frequency to a signal of large amplitude, the pip

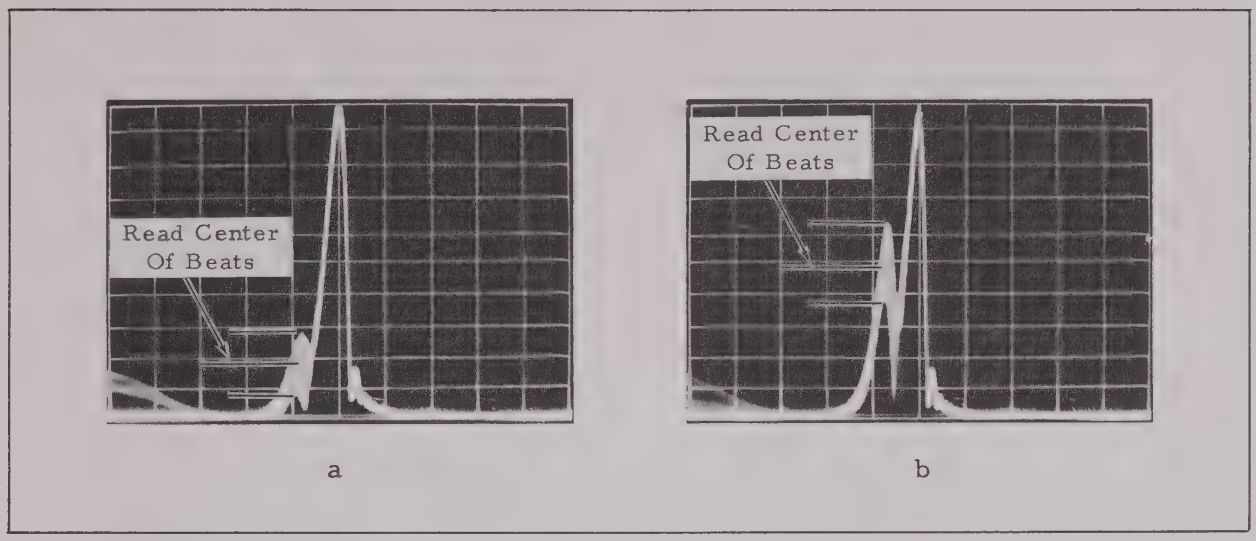


Figure III-5. Measurement of Closely Spaced Unequal Amplitude Signals.

representing the small amplitude signal will be influenced by the large amplitude signal (the amplitude-versus-frequency response of the i-f section being bell-shaped). As the signals are separated in frequency, the error becomes less. The minimum frequency separation required to measure amplitude ratios E_2/E_1 for the equipment can be determined from Figure III-3.

If adjacent signals have a large amplitude difference, RESOLUTION control settings which depict the signals as definitely separated pips should be used. Waveforms (a) through (f) of Figure III-4 illustrate the progressive variation in pip separation of two signals as the RESOLUTION control is rotated in a counterclockwise direction. In these illustrations sweep width = 500 KC, Frequency Separation = 50 KC, sweep rate = 30 cps, E_2/E_1 = 12 db.

In (a) i-f bandwidth is broad. In (b) and (c) the smaller pip begins to emerge as bandwidth is narrowed. In (d) definite separation of pips is seen. However, due to beating of the two signals, the amplitude indication of the smaller pip is higher than its final value. In (e), beginning of ringing on the left side of the large pip shows i-f bandwidth approaching an optimum value. The extent of ringing in (f) shows that optimum i-f bandwidth has been reached. Highest accuracy of relative amplitude measurements results when adjacent signals are completely resolved.

To obtain greater resolution by increasing the scanning time, lower the sweep rate by rotating the SWEEP RATE control counterclockwise. Readjust the SYNC AMP control to keep the sweep in synchronism. For better separation of signals, the SWEEP WIDTH and RESOLUTION controls can be rotated further counterclockwise and the SWEEP RATE control set for a slower rate.

Should it be necessary to observe a given bandwidth at one time with the contained signals closely spaced, best possible resolution is indicated by the clearest picture. A reasonably accurate measurement of relative amplitudes can be made by reading the center of the beats. This is illustrated in Figure III-5. The amplitude ratio in (a) is greater than the ratio in (b), resulting in a somewhat different presentation.

After the clearest picture has been attained, further counterclockwise rotation of the RESOLUTION control will result in lessened resolution and bobbing presentations.

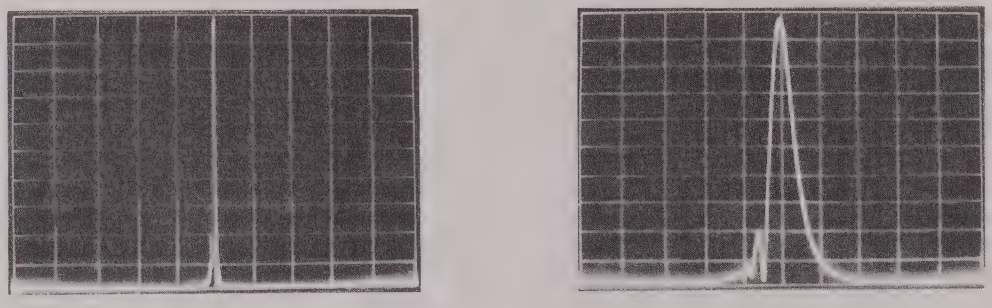
III-5. OPERATING PROCEDURE FOR PULSED SIGNALS

Pulsed signals as displayed on the screen are composed of a series of deflections of relatively short duration. Therefore, a peak produced by one of these pulses traverses the screen so rapidly that the crt screen is insufficiently excited to produce a visible trace. Turning up the BRILLIANCE control does not help because increased brightness tends to wash out the pulse pattern. To overcome this situation, use the INTENSIFIER control as outlined below.

a. Follow the regular operating procedure.

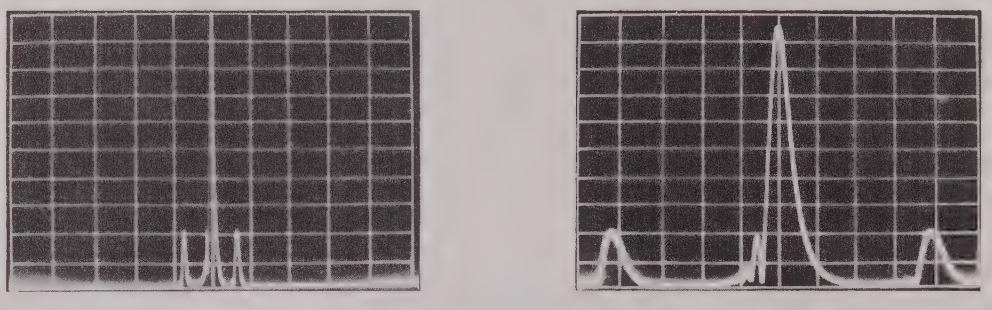
b. Reduce the intensity of the baseline trace until it is barely visible.

c. Turn the INTENSIFIER control clockwise. The pulse peaks should come into view while the



a b

Figure III-6. Constant Carrier Presentation



a b

Figure III-7. A-m Signal Presentations.

baseline is not equally apparent. If necessary, use the FOCUS control.

III-6. INTERPRETATION OF SIGNAL PRESENTATIONS

With a little experience, the operator will be able to recognize the appearance of the following various types of signal presentations:

a. A CONSTANT CARRIER appears as a deflection of fixed height; see Figure III-6 (a) and (b).

b. AN AMPLITUDE-MODULATED CARRIER appears as a deflection of variable height. Non-constant tone modulation of low frequency will produce a series of convolutions varying in height, their number being determined by the modulation frequency. The nature of the presentation will depend upon the sweep width; see Figure III-7 (a) and (b).

As the modulation frequency increases, convolutions move toward the two sides of the deflection, and sidebands tend to become visible. It becomes possible to separate sidebands by reducing sweep width of the Indicator. The RESOLUTION control will enable further separation. Higher-frequency modulation causes the bands to move away from the center deflections.

Because of possible non-linear amplifications of the Model SC-8b over a wide band, equal-strength sidebands may appear unequal in height. Their relative heights may change as the tuning is varied and the deflection moves across the screen.

c. FREQUENCY-MODULATED CARRIERS and PULSED r-f SIGNALS appear as shown on Figure III-8 (a) and (b).

d. A CARRIER, FREQUENCY-MODULATED

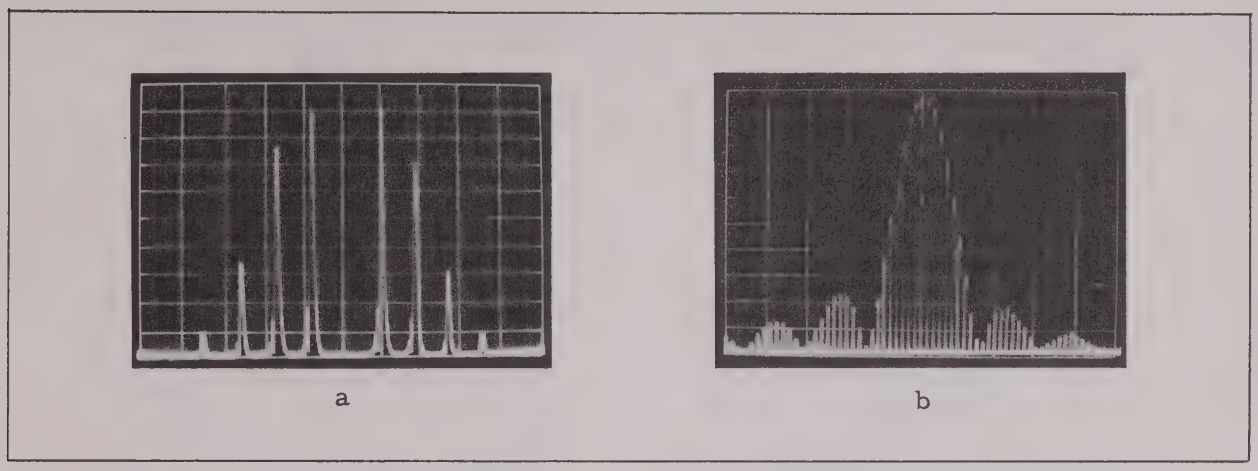


Figure III-8. F-m and Pulsed R-f Signals.

AT LOW RATE, appears as a carrier which wobbles sideways.

e. C-w SIGNALS appear and disappear in step with the keying of the signal source. During moments when the signal is off, the frequency sweep axis is closed at the base of the signal. In very rapidly keyed signals the deflection and the baseline are seen simultaneously. Mcw signals appear as c-w signals of varying heights. If the modulation rate is high, sidebands will appear.

f. SIGNAL INTERFERENCE. Two signals, so close in frequency as to cause interference (beats), may appear on the screen as a single deflection, varying in height, (See Figure III-9 (a)). As the frequency separation is increased, the deflection appears as if modulated on one side only. Further increase of frequency will cause a break in the apex of the deflection (See Figure III-9 (b)). By reducing the sweep width of the indicator, the respective deflections will gradually separate. Further separation is effected by using the RESOLUTION control and setting the SWEEP RATE lower. Single sideband modulation appears as two carriers of slightly different frequency.

g. TRANSIENT DISTURBANCES. Periodic transients, produced by motors, vibrators, buzzers, etc., appear as signals moving along the frequency-sweep baseline. An accelerating engine will produce a set of deflections which may move first in one direction, slow down, stop, and then move in the opposite direction.

This is caused by the Indicator sweeping at a fixed rate, and the transient occurring at a variable rate. The images stand still when there is synchronism between them. If the transient disturbance is synchronized with a 60-cycle line, noise appears as a fixed signal varying in height as the tuning is varied. Such deflections, may appear to be a-m signals or steady carriers. Aperiodic transients, like static, appear as irregular deflections and flash along the whole frequency sweep axis.

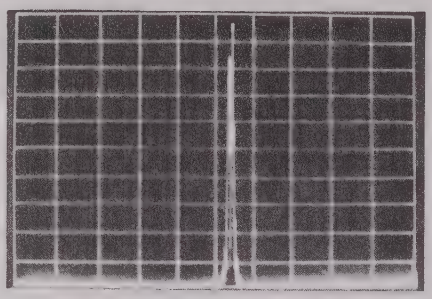
h. IMAGES are distinguishable from normal signals, because they move in an opposite direction with respect to normal signals as the tuning is varied.

i. HARMONICS produced in the mixer by beating very strong signals with harmonics of the oscillator, will be distinguishable from other signals because they move across the screen more rapidly than normal signals. A second harmonic spurious signal will move across the screen at double the normal signal speed. Generally a reduction in signal strength will eliminate this type of spurious signal.

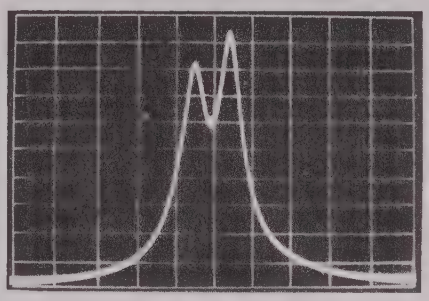
j. APPARATUS using an unfiltered or a-c power supply will produce periodic disturbances causing intermittent deflections to appear. These disturbances are caused by the equipment emitting signals which pulsate in synchronism with the power line. The Indicator while sweeping the spectrum, is also in synchronism with the line, but at a lower frequency. When certain phase relationships exist, the Indicator receives the periodic disturbances.

To examine signals synchronized to line frequency, set the CAL-SYNC SEL control to LINE, the SYNC AMP control fully counterclockwise, and adjust the SWEEP RATE control for the best presentation across the entire screen. This provides the asynchronous operation necessary to see the entire signal. The SYNC AMP control can provide synchronism to lock in an interesting portion of the display.

k. SPURIOUS SIGNALS. If signal strength

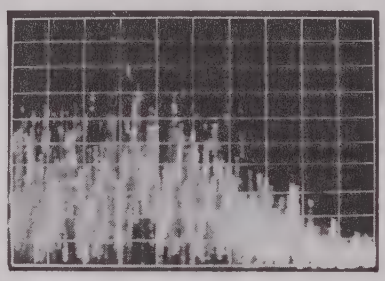


a

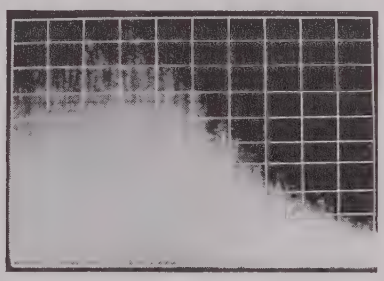


b

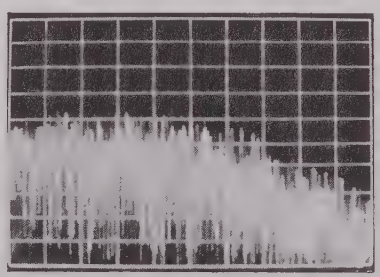
Figure III-9. Resolution of Interfering Signals.



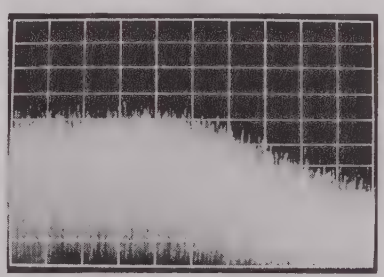
(a) LIN scale. Narrow i-f bandwidth.



(b) Same as (a) with extended photographic exposure.



(c) Same as (a) using LOG amplitude scale.

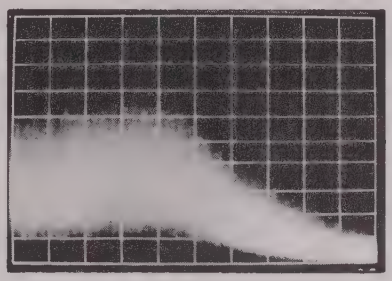


(d) Same as (c) with extended photographic exposure.

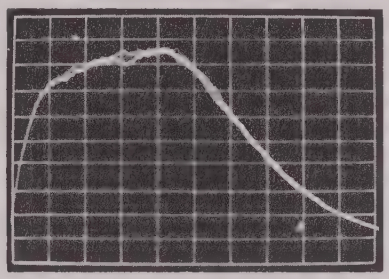
Figure III-10. Typical Screen Presentations of Noise Signals.

exceeds a certain value, a deflection caused by any signal disperses into a series of parallel deflections, similar to sidebands. Attenuation of signal input level will remedy this situation.

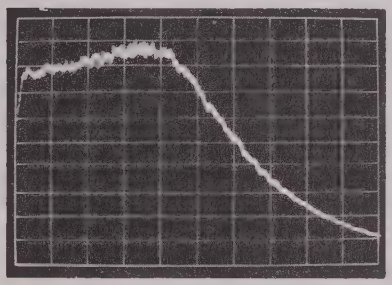
1. NOISE ANALYSIS. Noise or random signals are analyzed by using the same general techniques used for discrete signals. Wide i-f bandwidths produce better noise envelope averaging and are preferred for general noise analysis. If the noise sources are selective, narrow i-f bandwidths are required, permitting noise characteristics to be presented in fine detail. When narrow bandwidths are used, low sweep rates should be set to allow a small change in rate without a noticeable change in amplitude. Narrow



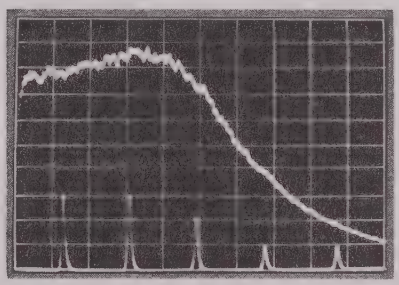
(a) LOG amplitude scale. Broad i-f bandwidth. One scan.



(b) Same as (a). Video filter used to obtain clear line presentation. Sweep rate too fast.



(c) Same as (b) with sweep rate adjusted for correct presentation.



(d) Same as (c) with marker presentation used to define frequency points (composite photo).

Figure III-11. Screen Presentations of Noise Signals using Wide I-f Bandwidth and VIDEO FILTER.

bandwidths increase equipment response to higher or lower than average noise amplitudes within the bandwidth.

If absolute noise measurements are required, a calibration of the Indicator using a known noise amplitude is necessary. The calibration must be made at the scanning velocity and i-f bandwidth to be used for measurement. In noise analysis, photographic averaging of noise level is accomplished by taking composite photographs of successive scan presentations.

Typical screen presentations at different settings and photographic exposure times are shown in the following figures. Figure III-10 (a) shows a single scan presentation of noise with the equipment set for narrow i-f bandwidth and LIN position. An extended photographic exposure of this presentation is shown in Figure III-10 (b). The identical noise presentations using LOG position are shown in Figure III-10 (c) and (d).

Wide bandwidths will provide a more typical display of noise amplitudes. A noise presentation using wide i-f bandwidth and LOG scale position setting is shown in Figure III-11 (a). Use of VIDEO FILTER control to obtain clearer noise spectra results in presentations shown in Figure III-11 (b) and (c). Markers may be used to define frequency points as shown in Figure III-11 (d).

CHAPTER IV
THEORY OF OPERATION

IV-1. INTRODUCTION

The Panoramic Indicator, Model SC-8b, is basically an automatic scanning superheterodyne receiver providing a visual display of signals within a selected bandwidth. The equipment consists of a broadband r-f amplifier, a sweeping oscillator and mixer, a variable selectivity dual conversion type i-f, a video detector and amplifier with three modes of amplification, a signal intensifier circuit, associated sweep circuits, a cathode-ray tube indicator, and a power supply.

The frequency range of the equipment is defined by the limits of the external generator and mixer with which it is used. A Model PS-8b Power Supply provides a regulated B+ voltage for all units, high voltage for crt operation, and all filament voltages. A block diagram of the Indicator is shown in Figure IV-1.

IV-2. BLOCK DIAGRAM ANALYSIS

The input signal frequency of 30 mc is applied to the r-f bandpass amplifier, at point A in Figure IV-1. The Model DA-1 Preamplifier, when used, is connected ahead of the r-f bandpass amplifier, as shown in Figure IV-1, and the input signal is applied to the preamplifier at point B. When the spectrum band to be analyzed is not within the Indicator range (25-35 mc) an external signal generator and mixer are connected as shown, and the input signal is applied to the mixer at point C. The external signal generator is set to oscillate at 30 mc above the incoming signal, so that the output of the mixer is a 30±5 mc signal required by the r-f bandpass amplifier.

The r-f bandpass amplifier compensates for the selectivity of the r-f and mixer stages, and provides greater gain in the displayed band of frequencies. The r-f amplifier output is applied to the mixer stage, where it is heterodyned with the output of the swept oscillator. Differential markers are also applied to the mixer stage.

The output of the mixer stage is applied to the first i-f stage (which is tuned to 23 mc), amplified, and then fed to the second i-f converter. This stage produces a signal of 650 *kc at its output, which is amplified by the second and third i-f amplifiers and then applied to the detector. A scale switch in the third i-f amplifier stage permits a choice of amplitude presentations. When in EXP position, an additional tube is used to provide exponential presentation. The output of the detector is applied to a video (vertical) amplifier and then to the vertical deflection plates of the crt, furnishing the screen presentation.

The sawtooth generator which feeds the reactance modulator to sweep the oscillator also furnishes the input to the horizontal amplifier, thereby causing the cathode-ray beam to horizontally scan the face of the crt. A sync amplifier connected to the sawtooth generator keeps the horizontal trace time in synchronization with its input.

A detailed description of the equipment units is presented in the following paragraphs.

IV-3. DETAILED DESCRIPTION OF PREAMPLIFIER, DA-1

The Preamplifier, Model DA-1 is provided as optional equipment to boost the signal sensitivity of the Indicator. It is a broadband, stagger-tuned amplifier consisting of six tubes and associated circuitry, and a power supply. An approximate 40 db sensitivity gain is obtained by incorporating this unit. A schematic diagram of the unit is shown in Figure IV-2.

a. AMPLIFIER CIRCUIT DESCRIPTION. Input signals fed into the INPUT jack are applied through the impedance matching transformer L1 to the grid of the tube V1, which is connected in a cascode arrangement with V2. Capacitor C2 and inductor L7 provide a low impedance ground return to the grid of V2. Peaked frequencies are applied to four following tuned-input amplifier stages V3, V4, V5, V6. Amplifier V3 is resonant to 25.4 megacycles, V4 to 28.1 megacycles, V5 to 31.9 megacycles and V6 to 34.6 megacycles. Signal output is applied through V6, a cathode follower stage with an output impedance of 50 ohms, to a step attenuator. From the attenuator the signal is applied to OUTPUT jack J2.

b. ATTENUATOR CIRCUIT DESCRIPTION. When the test signal level is of the order of the standard sensitivity of the Panoramic Indicator, the DA-1 should not be used. When using the DA-1 to amplify low level signals, the step attenuator is adjusted to obtain a suitable signal

* In sets bearing serial numbers 23H116 and below, (with a 5UP7 crt) or 24J 141 and below, (with a 5ADP7 crt) this second i-f signal is 500 kc instead of 650 kc.

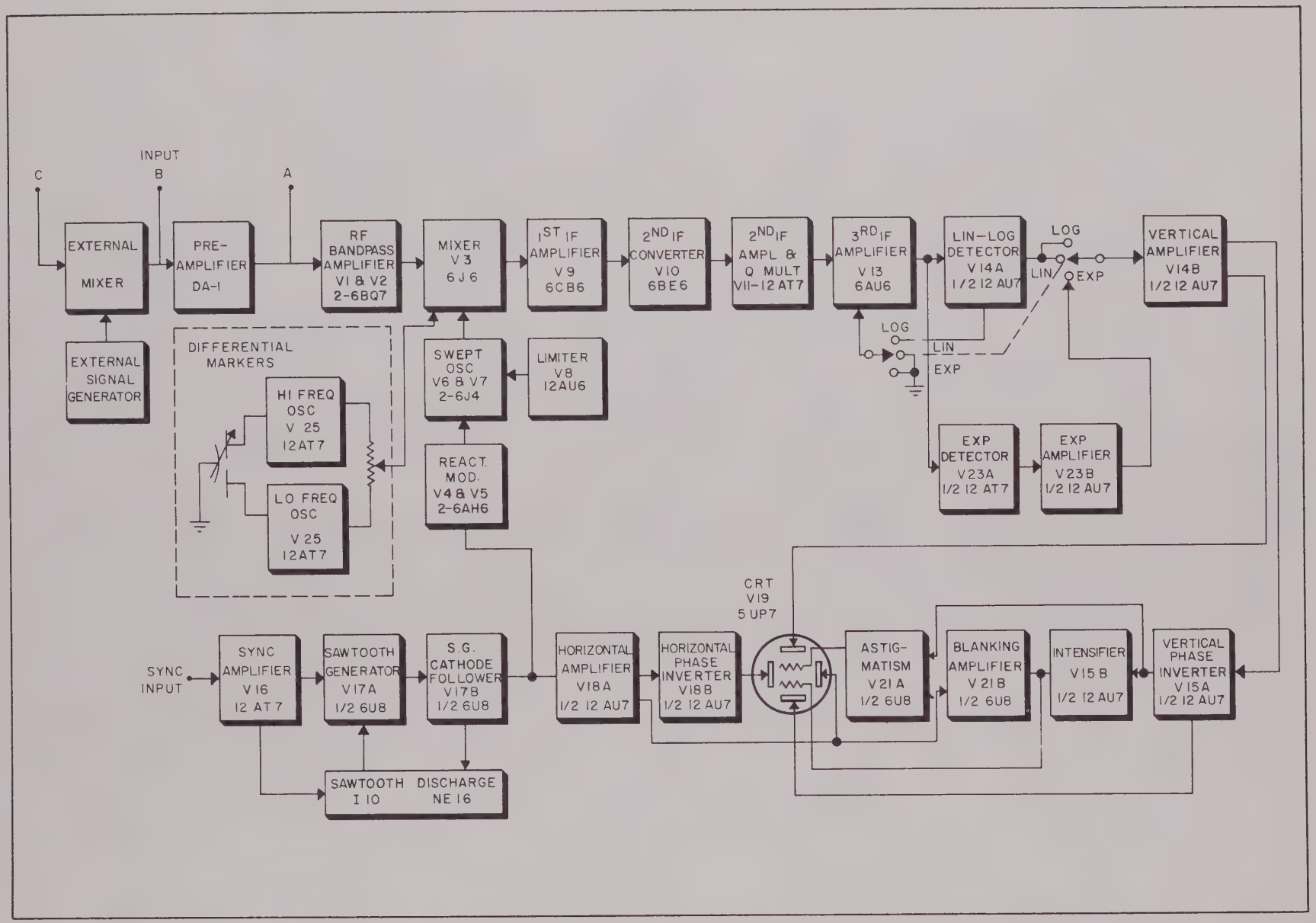


Figure IV-1. Functional Block Diagram, Panoramic Indicator, Model SC-8b.

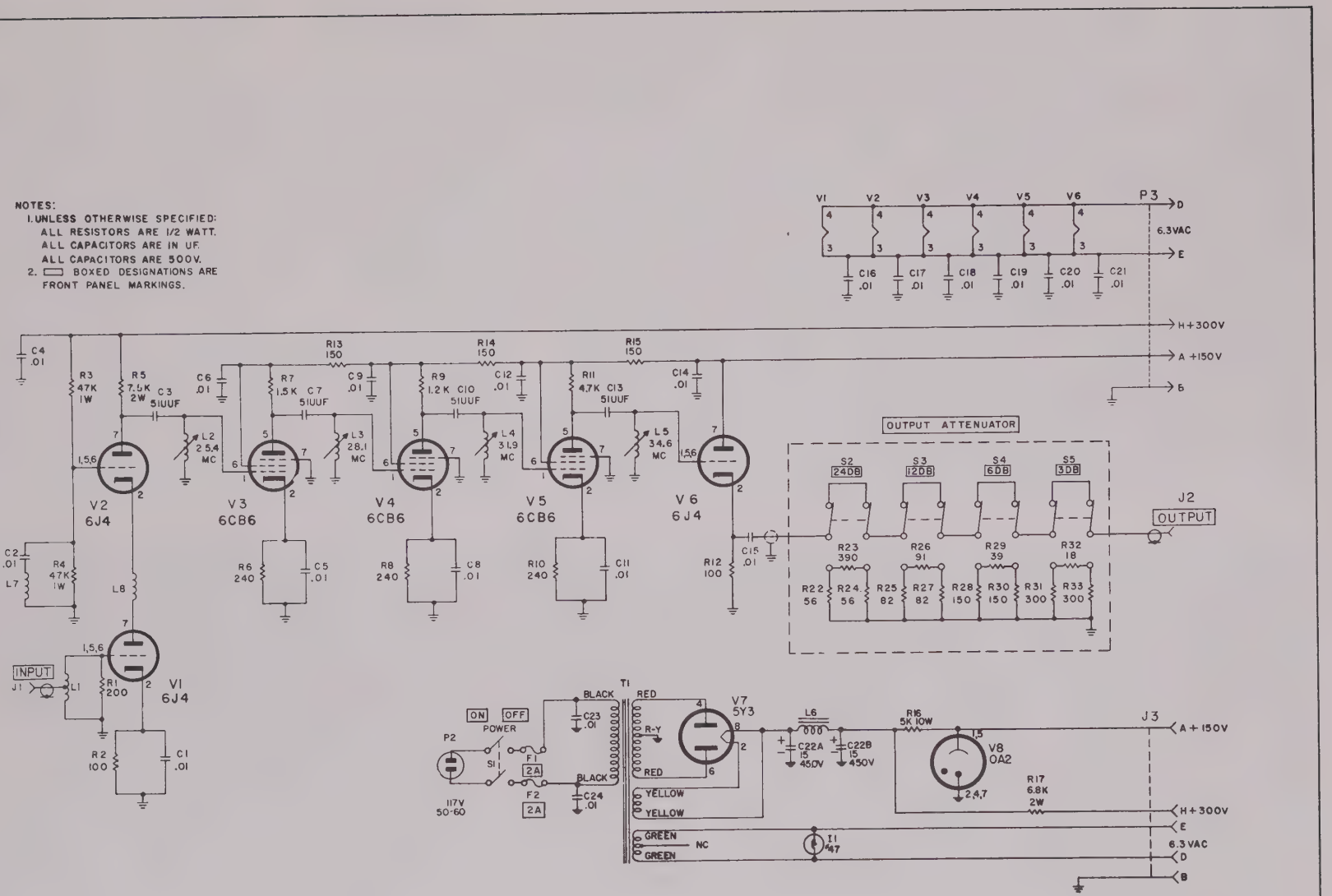


Figure IV-2. Schematic Diagram, Preamplifier, Model DA-1.

level into the Panoramic Indicator, and to reduce the noise level. The attenuator provides 0 to 45 db of attenuation. There are four switches, providing 3 DB, 6 DB, 12 DB, and 24 DB attenuation. Other steps of attenuation are obtained by combining two or more switch positions, e.g., switches 24 DB and 6 DB are thrown to obtain 30 db of attenuation. With the GAIN control of the indicator completely clockwise, the DA-1 attenuator is adjusted so that the maximum signal pip does not exceed full scale and noise on the screen is at an unobjectionable level. The GAIN control can be used as a fine gain adjust.

c. POWER SUPPLY CIRCUIT DESCRIPTION. The power supply in the DA-1 consists of power transformer T1, rectifier tube V7, and associated tube circuitry. Power is applied to the power transformer primary when ON-OFF switch S1 is set to the ON position. Secondary windings of transformer T1 are color coded as indicated in figure IV-2. Green leads supply 6.3 volts ac through terminals D and E of connectors J3 and P3 to tube filaments. Yellow leads supply 5.0 volts ac to rectifier tube filaments at pins 2 and 8. Red leads supply voltage to rectifier tube plates at pins 4 and 6. The output from the rectifier tubes is applied to a pi-type filter consisting of choke L6 and capacitors C22A and C22B. The +300 volt output of the filter is applied through resistor R17 to pins H of connectors J3 and P3. Regulator tube V8 is connected to the junction of resistor R16 and pin A of connector J3. This tube provides a +150 volt output at pins A of connectors J3 and P3. Any voltage variations are compensated for by changing the current through the regulator tube, which acts as a variable resistor in a divider network.

IV-4. DETAILED DESCRIPTION OF SC-8b INDICATOR UNIT

The SC-8b indicator unit is an automatic scanning superheterodyne receiver with a fixed 30 megacycle r-f input frequency. It consists of a fixed-tuned broadband r-f amplifier, a reactance modulator, a sweeping-oscillator and mixer, variable selectivity i-f amplifiers, a detector, a video amplifier with selectable gain ratios, a cathode-ray tube indicator, associated sweep circuits and a signal intensifier circuit. A schematic diagram of the SC-8b indicator is bound in the rear of this manual.

Input signals are amplified and applied to a mixer along with the sweeping-oscillator output, which progressively changes frequency. The resultant output is applied to the i-f section, where an output proportional to the amplitude of the scanned signal is produced. This output is detected, amplified and applied to the vertical deflection plates of the crt.

Oscillator sweep is obtained with a sawtooth-modulated reactance tube circuit. The sawtooth generator supplying the necessary modulating sawtooth voltage also provides horizontal sweep voltage. Therefore, the position of the spot on the crt face is dependent on the frequency generated by the sweeping-oscillator.

a. R-f CIRCUIT DESCRIPTION. The signal input at J101 is applied through impedance matching coil L701 to the grid of cascode amplifier V1. The output of the amplifier is applied through triple-tuned transformer T101 to the grid of V2. Resistor R707, in the grid circuit of V2, loads T101 and determines the broadness of frequency response in the r-f stage. The amplified output of V2 is applied through T102 to mixer stage V3. Tuned plate circuits LA and LB are 23-megacycle traps, used to avoid responses in the i-f stages. The resultant output of the r-f stage is a quadruple-peaked response with peaks at 24.8 mc, 28 mc, 32 mc, and 34.8 mc, and with an over-all peak-to-valley ratio of ±15 percent, as shown in Figure IV-3. GAIN potentiometer R703 controls the variable grid bias in the r-f stage.

b. REACTANCE MODULATOR CIRCUIT DESCRIPTION. A controlled sawtooth voltage is applied to the grids of reactance tube modulators V4 and V5, producing two outputs of equal phase and amplitude. These outputs are applied to opposite ends of center-tapped oscillator coil Z101. Effectively, the reactance tubes act as a variable inductance shunted across Z101.

As the sawtooth voltage on the reactance modulator grids rises from maximum negative amplitude to maximum positive amplitude, tube conductance increases. Because of the phase shift introduced by phase shifting networks R969 with C968, and R972 with C970, the plate current of the reactance tubes is fed to the oscillator tuned circuit as an inductive current. When this

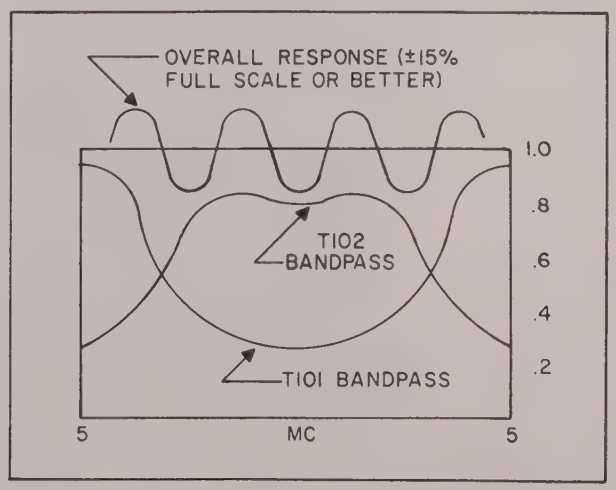


Figure IV-3. Resultant Output of R-f Stage.

current increases, the resonant frequency of the tuned circuit shifts to re-establish equality between the inductive and capacitive currents, resulting in a higher oscillator frequency.

The extent of frequency excursion is determined by the applied sawtooth amplitude. Variation of amplitude is accomplished with the Sweep Limit screwdriver adjust control R32, shown in Figure V-1 or the SWEEP WIDTH control R33 on the front panel. When the applied sawtooth voltage is zero volts, the oscillator produces its mean frequency of 53 megacycles. By controlling reactor modulator bias, the oscillator mean frequency becomes adjustable. CENTER FREQ control R977 is a fine cathode bias control and C.F. Pad R975 is a coarse bias adjustment used to restore or maintain oscillator mean frequency. To eliminate hum pickup and isolate the modulator tubes from possible power supply fluctuations, d-c filament voltage and regulated plate voltage are used.

c. OSCILLATOR CIRCUIT DESCRIPTION. The swept oscillator circuit consists of modified push-pull connected triodes V6 and V7, in conjunction with plate tuned circuit Z101 and stray capacitances. The cathodes of both tubes are r-f grounded, but receive a d-c bias voltage from center frequency controls R975 and R977. With zero voltage impressed across Z101, the oscillator circuit operates at its mean frequency of 53 megacycles. Coil Z101 is adjustable to compensate for mean frequency variation caused by component variations.

When the reactance modulator causes an inductance variation of coil Z101, oscillator output frequency varies accordingly. As the sawtooth voltage applied to the reactance modulator varies from maximum negative to maximum positive, the oscillator frequency varies proportionately from 48 to 58 megacycles. A constant voltage amplitude is maintained over the oscillator frequency range with limiter tube V8.

d. LIMITER CIRCUIT DESCRIPTION. Limiter stage V8 is an automatic regulator for oscillation amplitude over the entire frequency range. The r-f output of oscillator V6 is rectified by crystal diode CR960 and applied to the control grid of V8 through resistor R962. With constant oscillator amplitude, d-c voltage level at the grid of V8 is constant, and the tube remains in a steady state. Any spurious r-f is bypassed to ground through capacitors C963A and C961. If oscillation amplitude increases, V8 conduction increases causing a greater voltage drop across plate resistor R961. This transient negative-going voltage is applied through C963B to the grids of V6 and V7, decreasing the oscillator gain. The procedure reverses when the oscillation amplitude decreases.

e. DIFFERENTIAL MARKER CIRCUIT DESCRIPTION. The differential marker circuit consists of two grounded-plate Hartley-type oscillators V24 and V25, which oscillate at mutually divergent frequencies from 15 megacycles. The resonant circuit of the grid of V24 varies in frequency from 15 to 17.5 megacycles as the resonant circuit of the grid of V25 varies from 15 to 12.5 megacycles. This is accomplished with split-stator capacitor C942, which is common to both oscillator circuits. When both circuits are resonating at 15 megacycles, the capacitance in the V24 circuit is at maximum and the capacitance in the V25 circuit is at a minimum. As the rotor is turned, capacitance will decrease in the V24 tuned circuit, and increase a proportional amount in the V25 tuned circuit.

The outputs of both oscillators are applied through their respective interstage cathode followers to opposite ends of the MARKER BALance potentiometer R945A, which enables the operator to adjust both marker oscillator signals to equal amplitude levels. These are then applied to the resistor network consisting of R951, R952, and potentiometer R945B. Varying R945B varies the amplitude level of both marker oscillator signals.

The output of the marker oscillator circuit is coupled through capacitor C711 to the grid of the mixer tube V3. Second harmonics of the marker oscillator frequencies mix with the swept-oscillator output frequencies and appear as c-w signals on the crt. The ability to vary these pips with the marker controls distinguishes them from bonafide signals.

If DIFFERENTIAL MARKERS control indicates 4, markers will be approximately 4 megacycles apart, equidistant from the baseline center. These markers at the 28 and 32 megacycle positions along the baseline represent second harmonics of the actual marker oscillator frequencies of 14 and 16 megacycles respectively. Thus, at the marker oscillator frequency extremes of 12.5 and 17.5, marker pips will appear on the baseline at the Indicator limits of 25 and 35 megacycles. When both marker oscillators are tuned to 15 megacycles, a single pip will appear at the center of the baseline. The sum frequency of the marker oscillators is always 30 megacycles; therefore a small pip will appear at the center of the baseline when the MARKER AMP control is adjusted to produce high amplitude-level markers.

Marker circuit filament voltages are applied when the equipment is energized. When plate voltage is applied to this circuit by closing switch S941, no warm-up delay is experienced, enabling accurate markers to appear on the crt instantaneously.

f. MIXER CIRCUIT DESCRIPTION. Mixer

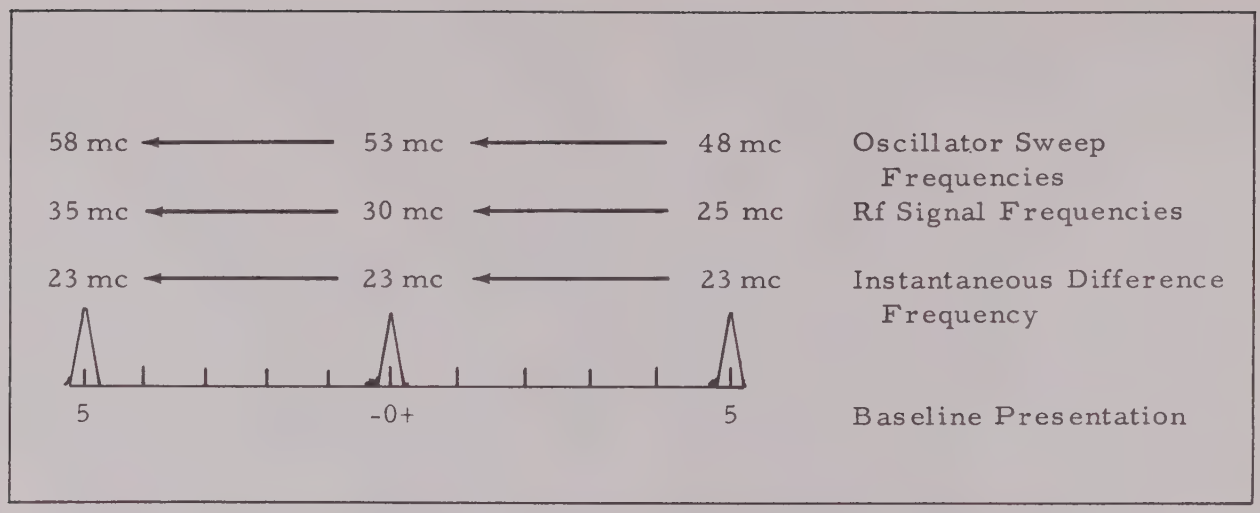


Figure IV-4. Relationship of R-F Signal Frequencies and Oscillator Sweep Frequencies.

stage V3 uses a common-cathode duo-triode. Amplified signals from the r-f stages are applied to the grid of the first triode section of V3. This tube is biased by the network consisting of capacitors C712 and C713 and resistors R713, R714, and R722. The resistance value of R722 is chosen to provide correct positive grid bias for optimum detection slope. The swept oscillator output is coupled into the grid of the second triode section of V3 through capacitor C927, and is also cathode-coupled to the first half of the mixer. Marker inputs, when used, are connected to the input jack J105 and are applied at the junction of isolation resistor R712 and the biasing network. The mixer stage output is applied to the first i-f transformer Z102.

Assume that the amplified r-f signals applied to the grid of the first triode section of V3 are at frequencies of 25, 30, and 35 mc. (See Figure IV-4). As the swept oscillator starts its upward frequency sweep from 48 to 58 mc, the instant a 48 mc signal is applied to the grid of the second triode section of V3 for mixing, only the 25 mc input signal will produce the necessary 23 mc difference frequency for application to i-f stage V9. Because the oscillator sweep is coincident with the crt horizontal deflection, the 25 mc signal pip will appear at the right hand limit of the calibrated baseline. At oscillator mean frequency of 53 mc the 30 mc input signal will produce a 23 mc difference frequency and coincidentally appear at the baseline center as a pip. Similarly, the 35 mc signal will appear at the left limit of the calibrated baseline when the oscillator frequency reaches its maximum value of 58 mc.

g. 1st I-f AND CONVERTER DESCRIPTION. The first i-f and converter section consists of amplifier stage V9, converter stage V10, transformers Z102 and Z103, oscillator circuit Z104, and plate tuned circuit Z105. Mixer output signals of 23 megacycles are applied through i-f transformer Z102 and resistor R900 to the grid of V9. After amplification, they are applied through i-f transformer Z103 to the grid (Pin 7) of the converter V10. Circuit response width is made narrow for increased selectivity. I-f gain potentiometer R904 in the cathode circuit controls the minimum gain level for the equipment.

Tube V10 is a pentagrid converter serving as a combination oscillator and mixer. The cathode tuned circuit Z104 oscillates at 22.35 mc. This oscillator output frequency is applied to the grid of V10, where it mixes with the 23-mc signal input to grid 3 (Pin 7). The output difference frequency of 650 kc is applied to tuned plate coil Z105 for greater selectivity before application to the second i-f amplifier section.

NOTE

In equipment bearing serial numbers 23H116 and below (with a 5UP7 crt) or 24J141 and below (with a 5ADP7 crt) the cathode tuned circuit Z104 oscillates at 22.5 mc, and the output difference frequency applied to the tuned plate coil Z105 is 500 kc.

h. 2nd IF AMPLIFIER CIRCUIT DESCRIPTION. The 2nd IF amplifier section includes the variable resolution stage V11, the 3rd IF amplifier V13, lin-log detector and video (vertical) amplifier V14, exponential detector and amplifier V23, and switching circuitry to provide either linear, logarithmic, and exponential sweep magnitudes.

1. Variable Resolution Stage V11. The

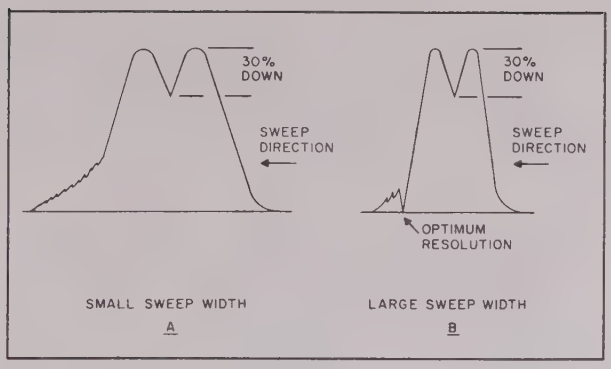


Figure IV-5. Indications of Resolution

2nd IF output from the tuned plate coil Z105 is coupled through RESOLUTION potentiometer R910A to transformer Z106. The transformer primary is connected to the grid of V11 (Pin 2); the secondary output is coupled through capacitor C912 and potentiometer R910B to the cathode of the same tube. Although the circuit is regenerative, loading provided by potentiometer R910 prevents oscillation.

When test signals merge, it is necessary to resolve, or separate, these signals. Resolution depends on three factors; video bandwidth, sweep rate, and sweep width. Controlling these factors with the RESOLUTION, SWEEP RATE, and SWEEPWIDTH front-panel controls enables the operator to select an optimum resolution combination. Figure IV-5 represents resolution at a small sweep width and at a comparatively larger sweep width.

Optimum resolution is indicated when the first ringing pulse at the signal trailing edge touches the baseline. To observe ringing effect, the VIDEO FILTER control S13 must be switched to the OUT position. To achieve optimum resolution at different sweep widths and rates, the 2nd IF amplifier bandwidth must be varied. Variation of 2nd IF bandwidth is accomplished with the three-section RESOLUTION potentiometer R910. Section A of R910 series-loads the primary of transformer Z106. Section B of R910 series-loads the secondary of transformer Z106. As the loading of Z106 increases, the Q decreases and the response width consequently broadens. Response width narrows as loading is decreased. With this method, the response width can be varied from 9 to 85 kilocycles. Section C of potentiometer R910 maintains the circuit gain at a constant level.

2. 3rd IF Amplifier Stage. The AMPLITUDE SCALE switch S10 allows selection of three types of signal amplification; linear, logarithmic, and exponential. Circuit operation in each position of S10 is described in the following paragraphs.

(a) LIN position. In the LIN position of S10, grid resistor R918 is grounded and V13 is cathode biased, resulting in linear amplification. Screen-grid resistor R923 aids linearity. The amplified output at the plate of V13 is applied to double-tuned plate tank Z107, resonant to 650 kilocycles (500 kilocycles, in equipment bearing serial numbers 23H116 and below and 24J141 and below.) The primary of Z107 is decoupled from B+ fluctuations by capacitor C6C. The output at the Z107 secondary is directly applied to the cathode (Pin 8) of lin-log detector V14.

(b) LOG position. In the LOG position of S10, the grid of V13 is connected to ground through resistors R918, R920, and Log Scale Adjust potentiometer R927. A portion of detected signal voltage is fed back as negative grid bias and is directly proportional to signal level. As the signal level is increased, bias is increased, causing a decrease in tube gain. Therefore, higher level signals are amplified to a lesser degree than lower level signals. When viewed on the crt, these signals appear to be compressed. The extent of the compression is determined by the setting of Log Scale Adjust potentiometer R927. Shaping the plate current curve to conform with log zero position on the crt is aided by controlling screen bias with Log Zero Adjust potentiometer R921. The output of V13 is applied through Z107 to the cathode of lin-log detector V14.

(c) EXP Position. In the EXP position of S10, the grid of V13 is connected to ground through resistor R918; screen-grid resistor R924 is inserted; the output of low-pass filter Z108 is removed from the circuit; and the output at the plate (Pin 1) of V23 is applied to the grid (Pin 2) of V14 through coupling capacitor C26 and switch S10C.

The output of V13 is applied through transformer Z107 and capacitor C916 to the grid (Pin 7) of the exponential detector and amplifier V23A. The output of V23A, tapped from the cathode, is proportional to the square of the input signal amplitude. It is applied to the grid of V23B through a tuned circuit consisting of coil L980, capacitor C980, and resistor R72. The output at the plate of V23B is coupled through capacitor C26 to the grid of V14. D-c restorer CR2, in the grid circuit of V14, is incorporated to compensate for the loss of d-c level.

3. Lin-Log Detector and Amplifier V14. Tube V14 is a duo-triode, with the grid and plate of the first section tied together to form a diode detector. In LIN or LOG position, rectified voltage appearing across the load potentiometer R927 is coupled through low-pass filter Z108. Video frequencies are coupled through Z108 to the grid (Pin 2) of V14. The cathode (Pin 3) is positive-

biased, and supplies a back bias to the other cathode (Pin 8). This maintains the plate current slopes of both tube sections as near optimum as possible regardless of signal amplitude.

High frequency components of narrow pulses are bypassed to ground when the VIDEO FILTER switch S13 is turned to HIGH or LOW position. In HIGH position, capacitor C2 is connected to the grid and frequencies above 200 cps are bypassed. The equipment is normally used with switch S13 in the OUT position, and signals are viewed without the distortion introduced by the video filter. The output at the plate of V14 is applied directly to one vertical deflection plate (Pin 10) of the crt, and to the grid of V15 through the coupling network consisting of capacitor C4 and resistor R6.

Video signals from amplifier V14 are applied to the grid of V15. These signals produce an output at the plate (Pin 1) 180 degrees out-of-phase but equal to input signal amplitude and time of occurrence. As video signals from V14 are applied to the vertical deflection plate (Pin 10) of the crt, equal but opposite signals produced by V15 are applied to the other vertical deflection plate (Pin 9). Vert. Pos. potentiometer R11 controls the sweep position by varying the d-c bias on the cathode of V15.

In LINE or EXT position, the CAL-SYNC SEL switch S11B returns cathode resistor R9 to ground. In CAL position, a 6.3 volt, 60 cps signal is superimposed on the cathode of V15. The amplified signal at the plate is applied to the vertical deflection plate (Pin 10) of the crt, resulting in a 60 cps sinusoidal vertical deflection. The output at the plate of V15 is also coupled through resistor R7 and capacitor C5 to the grid (Pin 7) of the second section of the tube.

i. INTENSIFIER CIRCUIT DESCRIPTION. The INTENSIFIER control varies the output magnitude by controlling the bias on this grid. Signals applied to this grid are amplified by the tube and capacitively coupled through C18 and resistor R56 to the control grid of the crt. When BRILLIANCE control R53 is adjusted to cut off the crt beam, signals from the intensifier tube override the bias and allow passage of the beam while being simultaneously applied to the vertical deflection plates. Intensifier tube V15 also increases signal peak intensities enabling them to be emphasized on the screen.

j. ASTIGMATISM AND BLANKING CIRCUIT DESCRIPTION. Tube V21 is a sharp-cutoff pentode that reduces trace defocusing and applies negative-going blanking pulses to the crt. Astig. Control R61 sets the voltage on the cathode and is normally adjusted with the intensifier tube grid (Pin 7 of V15) shorted to ground. In normal use, the grid (Pin 9) of V21 and the grid (Pin 7) of V15 receive the same signals. The output of V21 continually focuses the varying beam current caused by the coincident output of V15, thereby acting as an electronic focusing control.

A differentiated sawtooth voltage from horizontal amplifier V18 is applied to the grid (Pin 2) of V21. This tube section produces a negative-going pulse that is simultaneously applied to the control grid of the crt and to the plate of the intensifier tube V15. During the retrace time, this negative-going pulse blanks the horizontal sweep and inhibits the output of V15.

k. HORIZONTAL SWEEP CIRCUIT DESCRIPTION. The horizontal sweep circuit consists of sync amplifier V16, sweep generator V17, and sweep amplifier V18. A portion of the sweep generator output is fed back to reactance modulator tubes V4 and V5, causing them to modulate the sweep oscillator in synchronization with the horizontal sweep.

1. SYNC AMPLIFIER V16. When the CAL-SYNC SEL. switch S11A is in CAL or LINE position, a 6.3 volt, 60 cps signal is applied through capacitor C7 and resistor R14 to the grid (Pin 2) of V16. In EXT position sync voltage from an external source is applied through J103. A square wave output produced at the plate is coupled through capacitor C8 and resistor R19 to the other grid (Pin 7) of V16. Differentiated pulses are produced at the plate of this section of V16 and are applied through capacitor C9 and SYNC AMP potentiometer R22 to the sweep oscillator discharge tube I-10. Potentiometer R22 controls the magnitude of the differentiated pulses. Tube I-10 is a modified NE-16, having an electrostatic coating. The voltage pulses from the plate of V16 change the firing level of I-10 when applied to the electrostatic coating, causing the bulb to discharge sooner than if it were dependent on circuit time-constant parameters. This enables the sync pulse to determine the sweep start. A type-47 pilot bulb, located near the I-10, maintains a constant level of ionization in the neon lamp through its illuminating action. This keep-alive action prevents erratic sweep circuit operation.

2. SWEEP GENERATOR V17. The sweep generator circuit consists of sharp cutoff pentode V17, neon lamp I-10, and a resistance-capacitance network consisting of resistor R23, dual potentiometer R24, and capacitor C12. The pentode section of V17 is connected as a Miller-type sweep generator, and the triode section is used as a cathode follower. When the equipment is energized, negative bias at the grid (Pin 2) is sufficient to maintain the pentode section of V17 near cutoff, allowing the plate voltage to increase.

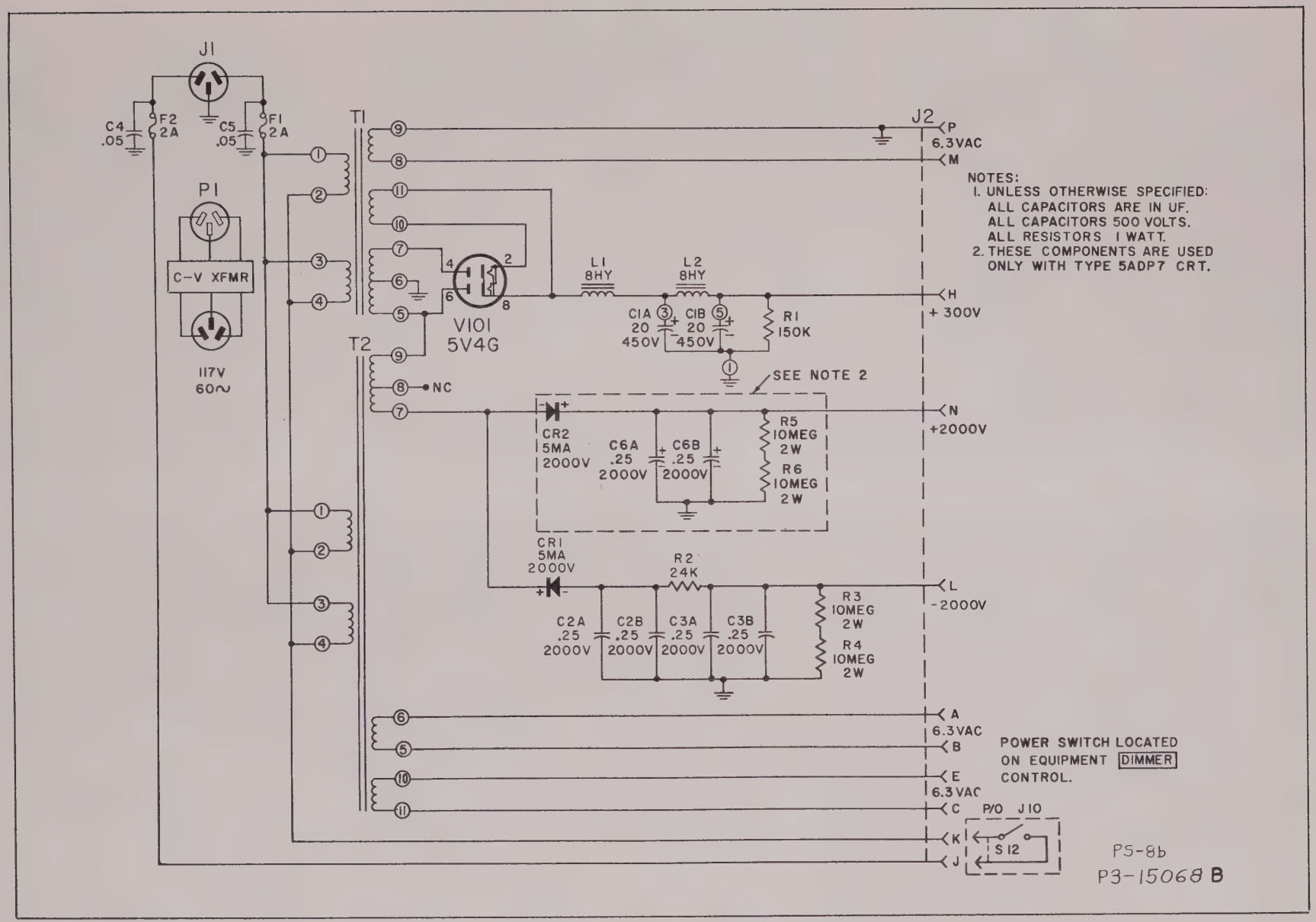


Figure IV-6. Schematic Diagram, Power Supply, Model PS-8b.

This positive-going voltage is applied to the grid of the cathode follower, increasing tube conduction. The steadily increasing voltage tapped from the junction of resistors R29 and R30 is fed back to the grid, multiplying the time constant of the circuit. When this steadily increasing voltage reaches the firing level of I-10, the neon lamp conducts, causing capacitor C12 to discharge. As C12 discharges, the grid (Pin 2) swings positive, increasing conduction and decreasing plate voltage to minimum potential. The bleed-off time of the positive charge on the grid is determined by the RC network. As the grid goes negative, the cycle repeats.

Section A of SWEEP RATE potentiometer R24 sets a negative level for the grid of V17; section B varies the RC network time constant. Clockwise rotation of potentiometer R24 results in shorter time constants and proportional decreases in grid bias. The output of V17 is taken from the cathode of the triode section, through capacitor C13, potentiometer R35, and resistor R34, and coupled to the grid of sweep amplifier V18.

3. SWEEP AMPLIFIER V18. The amplitude of the sawtooth signal applied to the grid (Pin 2) of duo-triode V18 is adjusted with the Line Size potentiometer R35; the amplifier gain is adjusted with Sweep Limit potentiometer R32; and SWEEP WIDTH potentiometer R33 controls the magnitude of the sawtooth signal applied to the junction of resistors R970 and R971 in the reactance oscillator circuit. The output at the plate of V18 is applied directly to one horizontal deflection plate of the crt; through resistor R60 and capacitor C17 to the grid (Pin 2) of blanking amplifier V21; and through resistor R45 to the grid of the second triode of V18. The output at the plate of this triode is applied directly to the horizontal deflection plate (Pin 8) of the crt. Hor. Pos. potentiometer R43 in the cathode circuit sets the d-c bias and governs the d-c plate voltage level of the amplifier. Adjustment of this potentiometer determines the horizontal position of the screen presentation.

1. CATHODE-RAY TUBE CIRCUIT DESCRIPTION. Two front-panel controls are provided for adjusting the crt beam. The BRILLIANCE control R53 adjusts cathode bias, and the FOCUS control R51 adjusts the focusing anode voltage for sharpness of trace. A hum-bucking network consisting of capacitors C15 and C29, and resistor R55 introduces out-of-phase voltages into the beam current to counteract a-c ripple.

IV-5. DETAILED DESCRIPTION OF POWER SUPPLY, PS-8b

Power Supply, Model PS-8b, consists of power transformers T1 and T2, rectifier V101, and associated tube circuitry. (See Figure IV-6) Power is applied to the power transformer primaries when POWER-OFF DIMMER switch S12 is turned clockwise. Voltages mentioned in the following description are nominal. Power supply performance depends upon the input voltage supplied by the constant voltage transformer.

The three secondary windings of transformer T1 are numbered as indicated in Figure IV-6. Leads 8 and 9 supply 6.3 volts ac through terminals M and P of connector J2. Leads 5 and 7 supply voltage to rectifier plates 6 and 5. These plates are connected to the high voltage secondary of T2 to prevent plate-to-cathode arcing within the tube. Leads 10 and 11 supply filament voltage to V101 at pins 2 and 8. Rectified voltage is tapped from pin 8 and applied to a filter network consisting of chokes L1 and L2, capacitors C1A and C1B, and bleeder resistor R1. The +300 volt dc output at the junction of R1 and L2 is applied to pin H of connector J2.

The three secondary windings of transformer T2 are numbered as indicated in Figure IV-6. Terminals 5 and 6 supply 6.3 volts ac to pins A and B of connector J2 for the crt filaments. The filaments are also connected to the -2000 volt dc supply to prevent cathode to filament arcing. Equipment high voltage is developed across terminals 7 and 9. This a-c voltage is applied to the junction of rectifiers CR1 and CR2. Through CR1 the voltage is applied to a filter circuit consisting of capacitors C2 and C3 and resistors R2, R3 and R4. A -2000 volt d-c potential is tapped from the junction of resistors R2 and R3, and applied to pin L of connector J2. Through CR2 the voltage is applied to a filter circuit consisting of capacitor C6 and resistors R5 and R6. The output of the filter circuit is a +2000 volt d-c potential, applied to pin N of connector J2 and utilized only when the optional 5ADP7 cathode ray tube is supplied with the equipment. Terminals 10 and 11 supply 6.3 volts ac to pins C and E of connector J2 for application to bridge rectifier CR1 in the Indicator.

IV-6. DETAILED DESCRIPTION OF CONSTANT-VOLTAGE TRANSFORMER

When an alternating current of low voltage is impressed across primary winding (1) as shown in Figure IV-7, the resulting magnetic flux induces a voltage in secondary winding (2). Because of air gap reluctance of the shunt path, this voltage approximates the turn ratio voltage. As the primary voltage is increased, more flux is produced. When flux density causes inductive reactance of winding (2) to approach the value of capacitive reactance of C1 at the exciting voltage frequency, this circuit becomes resonant and the voltage obtained across winding (2) rises rapidly to a stable, predetermined value. This effectively

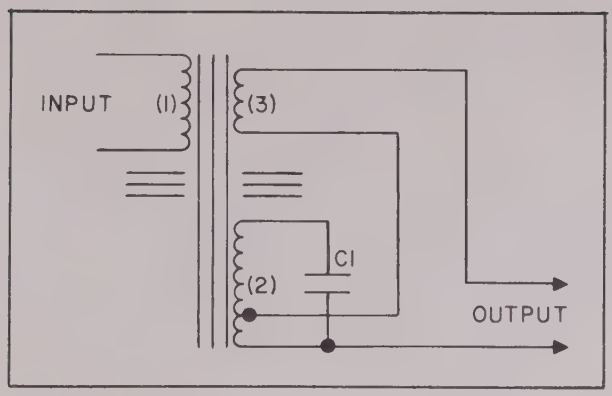


Figure IV-7. Schematic Diagram, Constant-Voltage Transformer.

increases magnetic density in that portion of the magnetic circuit on which the resonant winding is wound. Relative reluctance of the shunt system is greatly reduced and subsequent variations in flux largely absorbed, keeping voltage changes in the resonant circuit small. Compensation for these small changes is accomplished with winding (3). The shunt system also loosens effective coupling between the resonant circuit and primary winding (1). Once resonance is attained, the primary is required to supply only enough energy to overcome iron and copper losses of the system to maintain oscillation at no load. Because voltage across winding (2) is stable when resonance is attained it may be used as the basis of the constant voltage output of the transformer.

CHAPTER V
SERVICE AND MAINTENANCE

This chapter contains adjusting and alignment procedures, trouble-shooting information, and a replaceable parts list. When equipment trouble cannot be remedied with the procedures outlined in the following paragraphs, fill out the REPAIR AND MAINTENANCE FORM included in this manual and mail it to Panoramic Radio Products, Inc. Be sure to include the model number and serial number. Upon receipt of this information, our Service Department will send either service data or instructions for shipping the instrument to the factory for repair. If requested, a repair cost will be estimated before servicing the equipment.

V-1. TEST EQUIPMENT

The test equipment listed below or its equivalent is recommended for servicing and maintaining the Panoramic Indicator, Model SC-8b:

Quantity	Type and Model Number	Manufacturer
1	A-C Voltmeter, Model 330	Weston Electrical Instrument Corp.
1	Vacuum-Tube, Voltmeter, Model WV-77A	RCA
1	R-f Signal Generator, Model 82	Measurements Corp.

V-2. EQUIPMENT ADJUSTMENTS

The controls listed below are screwdriver adjusts, mounted on the Indicator chassis, and locked at proper settings with a locking bushing.

a. VERTICAL POSITIONING. The baseline may be moved vertically by varying the Vert. Pos. control. (See Figure V-1). Relative heights of signals displayed on the baseline will not change as the baseline is raised or lowered. It is possible to move the baseline up or down 1 - 1/2 inches. Set the Vert. Pos. control to obtain coincidence between the baseline trace and the lowest calibrated horizontal line on the screen. If trace and line are not parallel, rotate the crt.

WARNING

Before adjusting the physical position of the crt, turn power off, discharge power supply capacitors C2, C3, and C6, and disconnect the cabling between the Indicator and the power supply.

To rotate the crt, loosen the clamp around the crt socket and relax the bezel tension on the tube by loosening the bezel retaining screws. In equipment using a 5UP7 crt, the screen is fitted into detents in the bezel grommet and held in place by tube face pressure. A small adjustment may be made by a slight shift of screen position.

b. HORIZONTAL POSITIONING. The baseline may be moved horizontally by varying the Hor. Pos. control. Signals displayed as pips on the baseline will move with the baseline. Their positions relative to each other will not change. It is possible to move the baseline horizontally at least two scale divisions in either direction. Apply an external signal to the equipment and set the SWEEP WIDTH control to the zero position. Adjust CENTER FREQ. control for best baseline rise. Set SWEEP WIDTH control to maximum and adjust Hor. Pos. control until the pip is in line with the center frequency calibration on the frequency sweep axis.

c. LINE SIZE. This control linearly expands and contracts the horizontal baseline. Relative positions of signals will not change but resolution capabilities will be affected. Set Line Size control for a baseline length extending one-half division past each extrmity of the frequency sweep axis.

d. SWEEP LIMIT ADJUSTMENT. Turn DIFFERENTIAL MARKERS control to its 10 megacycle position. Adjust the Sweep Limit control until the baseline frequency markers line up at the +5 and -5 vertical lines on the frequency sweep axis.

e. C.F. PAD ADJUSTMENT. Set the C.F. pad to a position where the calibrated center frequency pips line up at the frequency sweep axis zero position.

f. ASTIGMATISM ADJUSTMENT. Apply a

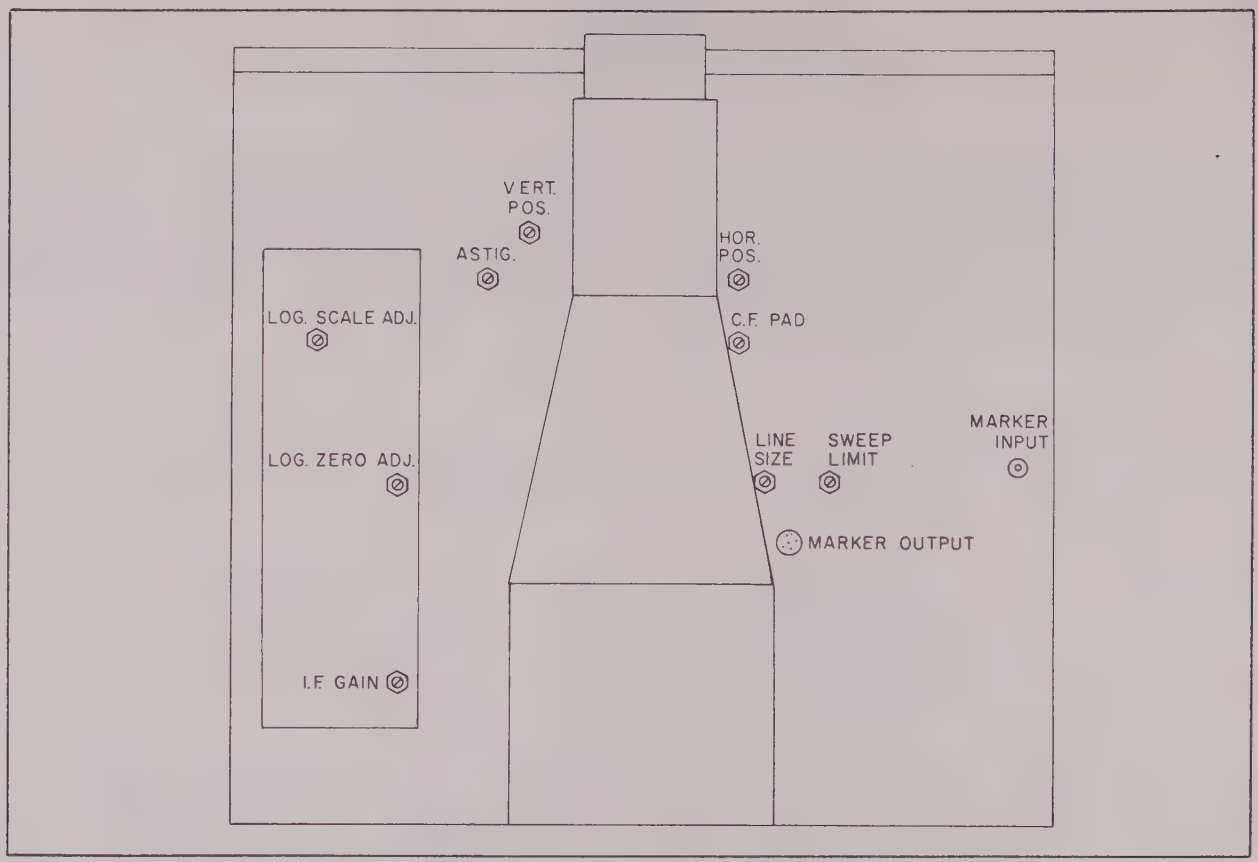


Figure V-1. Adjustment Locations (Indicator)

signal to the equipment of sufficient amplitude to cause full scale deflection. Set the INTENSIFIER control half-way clockwise and turn the BRILLIANCE control to obtain a moderately bright trace. As the pip traverses the baseline, adjust the Astig. and FOCUS controls until the baseline and pip are in sharp focus at all points, or until good over-all focus is obtained.

g. I-F GAIN ADJUSTMENT. When over-all gain is below specifications, set the front panel GAIN control to maximum, RESOLUTION control fully clockwise, and AMPLITUDE SCALE selector to LIN position. Apply a 75 microvolt, 30 megacycle signal to the equipment, and adjust the I-f Gain potentiometer for full scale deflection.

h. LOG SCALE ADJUSTMENT. With AMPLITUDE SCALE selector in LIN position, apply a 75 microvolt, 30 megacycle signal to the equipment and check for full scale deflection. Set the AMPLITUDE SCALE selector to LOG position and increase the amplitude of the input to 750 microvolts. Set the Log Scale Adjust to obtain full-scale deflection.

i. LOG ZERO ADJUSTMENT. With AMPLITUDE SCALE selector in LIN position, apply a 75 microvolt, 30 megacycle signal to the equipment and check for full scale deflection. Turn AMPLITUDE SCALE selector to LOG position and set Log Zero Adjust until the deflection indicates zero db.

NOTE

Because of circuit interaction, log scale adjustments may have to be repeated until the log scale is correctly calibrated.

V-3. TROUBLESHOOTING

The troubleshooting paragraphs and charts on the following pages may be used as an aid in locating possible causes of equipment malfunctions. The charts list probable causes and remedies of possible equipment failures. When the trouble has been localized, a tube check and voltage and resistance measurements should be sufficient to isolate the defective components.

Most parts of the equipment are readily accessible and easily replaceable. When a replacement requires removal of wires, mark the disconnected wires to eliminate rewiring errors. When replacing parts in r-f or i-f circuits, be sure the

replacements are of the same physical size and are mounted in the same physical positions as the original parts. Failure to observe these precautions may result in decreased gain or the introduction of undesirable oscillations in the circuit.

a. PANORAMIC INDICATOR, MODEL SC-8b.

SYMPTOM	PROBABLE TROUBLE	REMEDY
No baseline on screen when power switch S12 is turned on. Pilot lamp I2 does not light.	A-c power not being supplied to the Indicator.	Check power supply output. Check interconnecting cable.
Indicator operates normally but pilot lamp I1 does not light.	Pilot lamp or pilot lamp socket defective.	Replace pilot lamp. Check pilot lamp socket and replace, if necessary.
Pilot lamp lights, but there is no baseline on crt screen.	Improper adjustments of BRILLIANCE, FOCUS, Horiz. Pos., or Vert. Pos. controls.	Adjust these controls for the settings recommended in Section II-4b.
	Failure of B+ or high voltage supply.	Check the power supply.
All voltages correct, but no illumination on crt screen.	Defective crt.	Replace crt.
With GAIN control completely counterclockwise, a dot or short line appears, but horizontal sweep is unobtainable.	Faulty horizontal sweep stage.	Check sweep tubes V16, V17, V18, and tube socket voltages and resistances. Replace faulty components.
	Improper adjustment of line size.	Adjust LINE SIZE potentiometer R35 for proper length specified in Section V-2.c.
With GAIN control completely counterclockwise, the baseline is unstable in CAL and LINE positions of the Selector switch S11.	Faulty sweep stage.	Check sweep tubes V16 and V17 and their tube socket voltages and resistances. Replace faulty components.
	Horizontal oscillator not synched.	Adjust SYNC AMP control R22 as specified in Section II-4.b.5.
Horizontal baseline normal. No vertical deflection when GAIN control is fully clockwise.	No input signals, or low amplitude input signals, or off-frequency signals are being applied.	Check r-f cable from preamplifier. Check signal source.
	Defective r-f amplifier, mixer, or i-f circuit.	Check tubes V1, V2, V3, V9, V10, V11, V13, and tube socket voltages and resistances.
	Defective vertical deflection circuit.	Check vertical deflection tubes V14 and V15 and tube socket voltages and resistances.

SYMPTOM	PROBABLE TROUBLE	REMEDY
With SWEEP WIDTH control set at maximum, a vertical deflection representing a 30 mc signal does not line up with the center frequency line on the frequency sweep axis.	Improper adjustment of CF PAD, Hor. Pos., or CENTER FREQ. controls.	Adjust these controls as specified in Section V-2 & II-4.b.6.
With SWEEPWIDTH control set at maximum, no vertical signal deflection is observed, but the baseline appears to rise verically or tilt at an angle.	Defective reactance oscillator section.	Check tubes V4, V5, V6, V7, and V8, and tube socket voltages and resistances. Replace faulty components.
	Z101 detuned, or the SWEEPWIDTH control is misadjusted or defective.	Refer to Section V-4. Check SWEEPWIDTH control and replace if necessary.
Signal frequencies are not indicated accurately.	Improper alignment of bandpass amplifier.	Perform alignment procedures of Section V-4.
	Tube V1 or V2 defective.	Check tubes and socket voltages and resistances. Replace faulty components.
With SWEEPWIDTH control set at maximum, a vertical deflection representing a signal appears as a shift in the baseline.	Defective reactance tube modulator V4 or V5.	Check tubes and socket voltages and resistances. Replace faulty components.
Horizontal baseline does not span the desired limit with controls properly adjusted.	Defective horizontal sweep tubes V16 or V17.	Check tubes and socket voltages and resistances. Replace faulty components.
With SWEEPWIDTH and RESOLUTION controls fully clockwise and SCALE switch set to LIN position, tuning a signal across the bandpass does not result in a response as shown in Figure IV-6.	Improper r-f alignment.	Check V1 and V2, and socket voltages and resistances. Replace faulty components.
	If 35 mc end of response is low, the SWEEP LIMIT control R32 may be misadjusted.	Adjust SWEEP LIMIT control.
	Reactance oscillator is off frequency.	Check alignment of reactance oscillator, as outlined in Section V-4.
With GAIN and RESOLUTION controls fully clockwise, SWEEPWIDTH control 3/4 clockwise, and SCALE switch set to LIN position, a 30 mc input signal of 75 microvolts does not produce a full-scale symetrical deflection. Spurious signals appear as input amplitude is varied.	Improper i-f alignment.	Follow procedure outlined in Section V-4.
	I-f operating improperly.	Check tubes V3, V9, V10, V11, V13, and V15, and socket voltages and resistances. Replace faulty components.

SYMPTOM	PROBABLE TROUBLE	REMEDY
RESOLUTION control has no effect on pip shape.	Defective tube V11.	Check tube and socket voltages and resistances. Replace faulty components.
	Defective potentiometer R910.	Check continuity of potentiometer. Replace if necessary.
With GAIN and RESOLUTION controls fully clockwise, SWEEPWIDTH control 3/4 clockwise, and SCALE switch to LIN position, rotation of RESOLUTION control counterclockwise produces erratic or intermittent pip.	Noisy potentiometer R910.	Replace potentiometer.
With SWEEPWIDTH and RESOLUTION controls fully clockwise, and SCALE switch set to LIN position, erratic indications are observed at sweep extremes.	Defective mixer tube V3 or circuit.	Replace V3 if necessary. Several tubes may have to be tried before one is found with the proper tube chacteristics for the circuit. Z102 may require alignment.
60 or 120 cps modulation appears on signals.	Defective limiter tube V8, or voltage regulator V20.	Check tubes and replace if if necessary.
	Regenerative i-f or video stage.	Check tubes V3, V9, V10, V11, V13, V14, and tube socket voltages and resistances. Change faulty components.
LOG scale calibration is inaccurate.	Log Scale adjust and Log Zero adjust potentiometers are misaligned.	Check tubes V13, V14, and socket voltages and resistances. Adjust Log Scale and Log Zero potentiometers.
EXP scale calibration is inaccurate.	Defective tube V23 or CR2.	Check tube and crystal, and replace if necessary.
With no signal input, the horizontal trace cannot be adjusted vertically to line up with the frequency scale.	Defective Vert. Pos. control or tube V15.	Check Vert. Pos. potentiometer. Check tube and socket voltages and resistances. Replace defective parts.
	Regenerative i-f or video stage.	Check tubes V3, V9, V10, V11, V13, V14, and tube socket voltages and resistances. Replace faulty components.
With SCALE switch in LIN position, the tops of the pips flatten before full-scale deflection is reached.	Amplifier stages have reached saturation.	Check all tubes in r-f, i-f, and video stages. Replace if necessary.
	I.F. Gain control misadjusted.	Readjust I.F. Gain control.
No markers appear when MARKER AMP control is	Defective control R945 or switch S941.	Check voltages and resistances on these components.

SYMPTOM	PROBABLE TROUBLE	REMEDY
rotated clockwise, or they do not track properly when DIFFERENTIAL MARKERS control is rotated.		Replace faulty component.
	Defective tube V24 or V25.	Check tubes; replace if necessary.
	Marker circuit detuned.	Realign circuit as specified in Section V-4.e.
Only one marker appears when MARKER AMP control is set clockwise and DIFFERENTIAL MARKERS control is set anywhere off zero.	If plus (+) marker does not appear, V25 stage is defective.	Check tube V25 and tube socket voltages and resistances. Replace faulty component.
	If minus (-) marker does not appear, V24 stage is defective.	Check tube V24 and tube socket voltages and resistances. Replace faulty component.

POWER SUPPLY, MODEL PS-8b

SYMPTOM	PROBABLE TROUBLE	REMEDY
No +2000 volts at connector J2 terminal N.	Fuse F1 or F2 open.	Replace defective fuse.
	Open primary or secondary of transformer T2.	Check and replace transformer T2 if necessary.
	Defective rectifier CR2.	Check and replace rectifier CR2 if necessary.
	Defective power switch.	Replace POWER OFF DIMMER switch S12 if necessary.
Low +2000 volt output.	Low input voltage.	Check line voltage.
	Defective rectifier CR2.	Replace rectifier.
Ripple on +2000 volt output.	Defective CR2.	Replace rectifier CR2.
	Defective filter capacitor C6.	Check filter capacitor C6 and replace if necessary.
No +300 volts output at connector J2 terminal H.	Fuse F1 or F2 open.	Check and replace fuse.
	Open primary or secondary of transformer T1.	Check transformer and replace if necessary.
	Defective rectifier tube V101.	Check and replace tube, if necessary.
	Open coil L1 or L2.	Check coils and replace if necessary.

SYMPTOM	PROBABLE TROUBLE	REMEDY
Low +300 volt output.	Defective rectifier tube V101. Low input voltage.	Check and replace tube. Check input voltage.
Ripple on +300 volt output.	Defective filter circuit component.	Check L1, L2, and C1. Replace any defective part.
No -2000 volt output at connector J2 terminals L.	Fuse F1 or F2 open. Open primary or secondary of transformer T2. Defective CR1. Defective power switch.	Check and replace fuse. Check and replace transformer T2 if necessary. Replace rectifier CR1. Replace POWER OFF DIMMER switch S12.
Low -2000 volt output.	Low input voltage. Defective rectifier.	Check input voltage. Replace rectifier CR1.
Ripple in -2000 volt output.	Defective rectifier CR1. Defective filter capacitor C2 and C3.	Replace rectifier CR1. Check filter capacitors C2 and C3 and replace if necessary.
No 6.3 AC between J4 - M and J4 - P.	No input voltage. Open secondary of transformer T1.	Check input voltage. Check transformer T1 and replace if necessary.
No 6.3 V AC between J2-a and J2-B, or between J2-C and J2-E.	No input voltage. Open secondary of transformer T2.	Check input voltage. Check transformer T2 and replace if necessary.

V-4. ALIGNMENT PROCEDURE

Complete factory alignment procedures are included in the following paragraphs. These procedures should be used only if touch-up alignment techniques have been tried and have failed to yield satisfactory results. Before attempting to align the equipment, check that the correct voltage values are being furnished by the power supply. Allow the Panoramic equipment and the test signal generator to "warm up" for at least one-half hour before alignment is begun.

a. TUNING THE R-F, F-M OSCILLATOR, AND I-F COILS. Transformers T101, T102, Z101, Z103, Z104, Z106, and Z107 are tuned by means of movable iron cores. Windings at the top of the coils are tuned with a hollow iron core which may be turned with the pin end of the alignment tool supplied. The bottom windings may be tuned from either the top or the bottom of the transformer. In either case, the screwdriver tip of the alignment tool is used. When the bottom core is approached from the top, the tool is inserted through the top hollow core and finally engaged in the slot at the top of the lower core.

Set the front panel controls as follows:

INTENSIFIER .....completely ccw
GAIN 10
AMPLITUDE SCALE .....LIN
SWEEP RATE SELECTOR 30
BRILLIANCE.....bright trace
FOCUS.....sharp trace
VIDEO FILTER.....OUT
SWEEP WIDTH .....completely ccw

Connect a 0.01 uf capacitor in series with the output of the signal generator and proceed as outlined below:

b. I-F ALIGNMENT

Sig. Gen. Output	Signal Applied To	RESOLUTION Control Setting	Procedure
650 kc *	Pin 1 V13 6AH6	Clockwise	Tune top and bottom cores of Z-107 for maximum vertical deflection of the baseline.
650 kc *	Pin 2 V11 12AT7	Clockwise	Tune bottom core of Z-106 for maximum vertical deflection of the baseline.
650 kc *	Pin 2 V11 12AT7	Counter-clockwise	Retune bottom core of Z106 for maximum vertical deflection.
650 kc *	Pin 7 V10 6BE6	Clockwise	Tune top core of Z106 for maximum deflection of the baseline.
650 kc *	Pin 7 V10 6BE6	Counter-clockwise	Retune top core of Z106 for maximum deflection of the baseline.
650 kc *	Pin 7 V10 6BE6	Counter-clockwise	Tune bottom core of Z105 for maximum deflection of the baseline.
22 mc & 23 mc alternately	Pin 7 V10 6BE6	Clockwise	Tune bottom core of Z104 until deflections for both of these signals are maximum and equal.
23 mc	Standoff connecting through 9.1 ohm R900 to Pin 1 of V9	Clockwise	Retune Z104 for maximum deflection. Tune bottom core of Z103 for maximum deflection. Tune top core of Z103 for maximum deflection of the baseline.
23 mc	Standoff connecting through 9.1 ohm R900 to Pin 1 of V9.	Counter-clockwise	Retune bottom and top cores of Z103 for maximum deflection.
23 mc	Pin 5 V3 6J6	Clockwise	Tune top and bottom cores of Z102 for maximum deflection.
23 mc	Pin 5 V3 6J6	Counter clockwise	Retune top and bottom cores of Z102 and Z103 for maximum deflection.

*
In equipment bearing serial numbers 23H116 and below (with a 5UP7 crt) or 24J141 and below (with a 5ADP7 crt) the signal generator is set at 500 kc in these steps.

Sig. Gen. Output	Signal Applied To	RESOLUTION Control Setting	Procedure
30 mc	Pin 2 V2 6BQ7	Clockwise	Turn SWEEPWIDTH control fully clockwise. With pip appearing at the center of the screen, decrease the sweepwidth until the pip shape may be observed. Use CENTER FREQ control if necessary.
30 mc	Pin 2 V2 6BQ7	Counter-clockwise	Reset SWEEPWIDTH control to full clockwise position. Retune top and bottom cores of Z102 and Z103 for maximum and symmetrical pip. If a pip does not appear, proceed to the oscillator alignment described below, and return to this step after a pip has been obtained.

c. F-M OSCILLATOR ALIGNMENT

Keep the SWEEPWIDTH control in its full clockwise position, and set the CENTER FREQ control to its midpoint.

Sig. Gen. Output	Signal Applied To	Procedure
30 mc	Pin 5 of V3	Adjust the CF Pad (on top of the chassis) until the pip appears at the center of the screen.
25 mc	Pin 5 of V3	Adjust Z101 (under the chassis) until the center of the pip coincides with the right-hand edge of the screen, labelled +5.
35 mc	Pin 5 of V3	Adjust the Sweep Limit control (on top of the chassis) until the pip coincides with the left-hand edge of the screen, labelled -5. Repeat the above steps until all three signal frequencies (30, 25, and 35 mc) produce pips at their correct positions without the necessity of further adjustment.

d. R-F ALIGNMENT

Turn the SWEEPWIDTH control to its full counterclockwise position, and the RESOLUTION control fully clockwise. Proceed as follows:

Sig. Gen. Output	Signal Applied To	Procedure
23 mc	Input	Tune traps LA and LB for a minimum baseline deflection.
30 mc	Pin 1 T102	Set the SWEEPWIDTH control fully clockwise. Turn the coupling choke of T102 (Pin 5 at the bottom of T102) half-way out. Tune the top core of T102 for maximum pip height.

Sig. Gen. Output	Signal Applied To	Procedure
30 mc	Pin 1 T101	Turn the coupling choke of T101 (Pin 5 at the bottom of T101) completely counterclockwise until all the threads are showing from the bottom. (NOTE: Do not force.) Tune the top core of T101 for maximum pip height.
34.8 mc	Input	Tune the bottom core of T101 for maximum pip height.
24.8 mc	Input	Tune the coupling choke of T101 for maximum pip height.
25 mc to	Input	Vary the signal generator between the specified limits. The pip peaks should be of equal amplitude. If peaks are not equal in amplitude, tune the bottom core of T102 to equalize the peaks. Note that this core affects mainly the high-end peak. For this reason, the amplitude of the high-end peak should be matched to that of the low-end peak instead of vice versa. If at this point the flatness is not within specifications, tune the coupling choke of T102 to drop the lower peak approximately 10%, then tune the bottom core of T102 until the peaks are equalized. Continue to trim back and forth between the coupling choke and the bottom core of T102 until the flatness is within specifications. If, after following the foregoing procedure, the flatness is still not within specifications (i.e., if a center valley is present) it will be necessary to change resistor R707 to one of a lower value.

e. DIFFERENTIAL MARKER ALIGNMENT.

Set the SWEEPWIDTH control fully clockwise, and the RESOLUTION control fully counterclockwise. Throughout the following procedure, apply the output of the signal generator to the input jack J101.

Sig. Gen. Output	DIFFERENTIAL MARKERS Control Setting	Procedure
30 mc	0	With the MARKER AMP switch set to OFF, center the signal deflection pip over the zero mark on the sweep axis. Turn the MARKER AMP control to its midpoint, and adjust C940 and C946 to produce a single deflection pip.
35 mc	10	Adjust C941 until the signal deflection and the marker pip are in line.
25 mc	10	Adjust C943 until the signal deflection and the marker pip are in line.
30 mc	0	Readjust C940 and C946 (if necessary) until the signal deflection and the marker pip are in line.
27.5 mc	5	Adjust L947 until the signal deflection and the marker pip are in line.
32.5 mc	5	Adjust L940 until the signal deflection and the marker pip are in line. Repeat the entire procedure above (if necessary) to obtain good over-all tracking of marker pips.

f. PREAMPLIFIER, Model DA-1, ALIGNMENT.

Turn the RESOLUTION control fully clockwise. With the attenuator switches bypassed, and the output of the signal generator connected to the Input connector of the Preamplifier, proceed as follows:

Sig. Gen. Output	Signal Applied To	Procedure
25 mc	Input of Preamplifier	Adjust L2 on the Preamplifier for maximum deflection on the crt screen.
35 mc	Input of Preamplifier	Adjust L5 on the Preamplifier for maximum deflection on the crt screen.
28 mc	Input of Preamplifier	Adjust L3 on the Preamplifier for maximum deflection on the crt screen.
32 mc	Input of Preamplifier	Adjust L4 on the Preamplifier for maximum deflection on the crt screen.
25-35 mc	Input of Preamplifier	Tune the signal generator between these two frequencies and check for over-all flatness of response. Because of coil interaction, slight detuning of some peaks may be necessary.

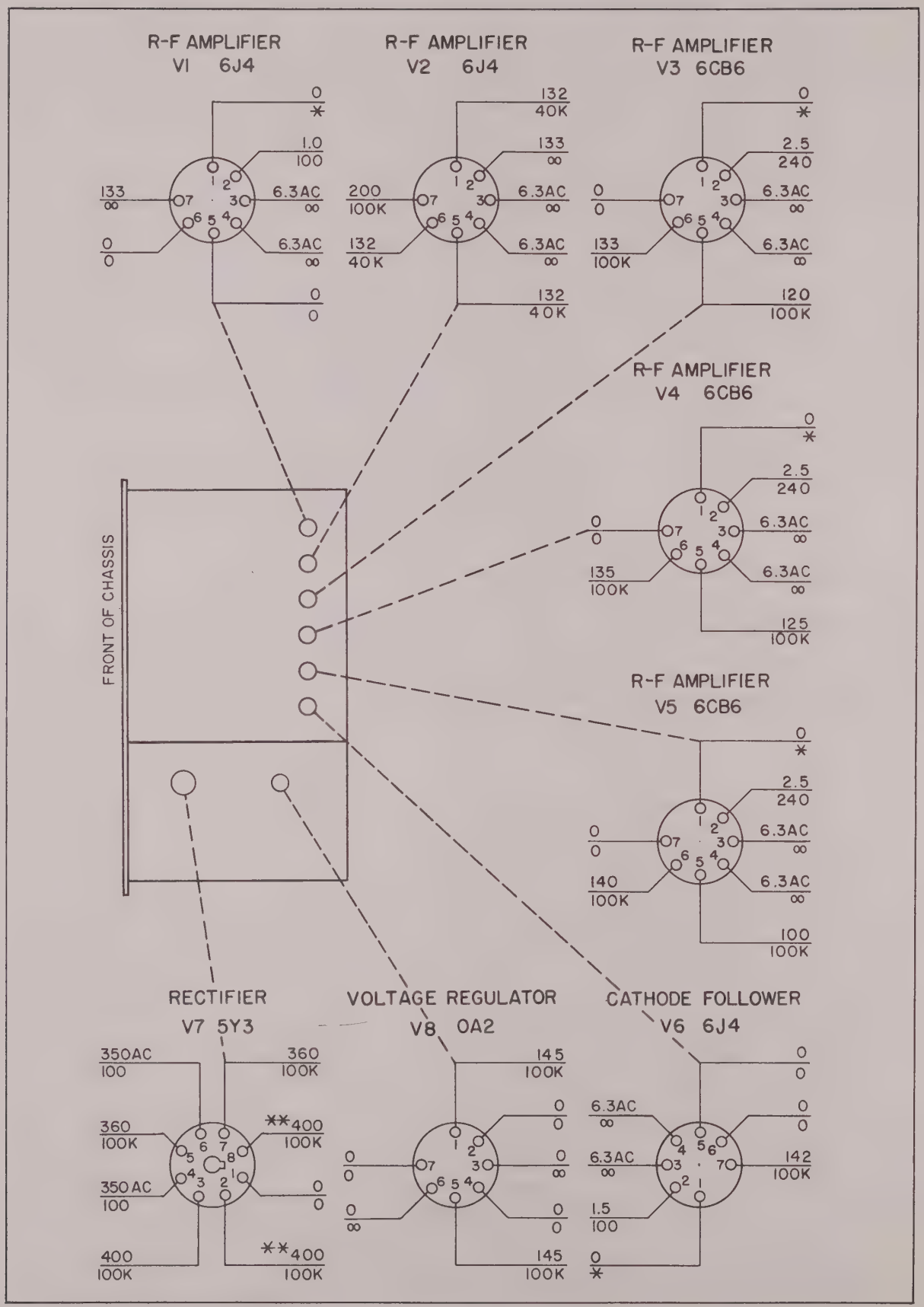
V-5. VOLTAGE AND RESISTANCE MEASUREMENTS

The voltage and resistance measurements listed on the following charts should be used as an aid in locating and isolating causes of equipment malfunctions. These indications are taken from all tube socket pins to ground. An RCA type WV-77A vacuum tube voltmeter was used for all measurements. Resistance measurements were taken with the equipment line cord removed and the power switch to the on position. All measurements were taken with the front panel controls in the positions listed below.

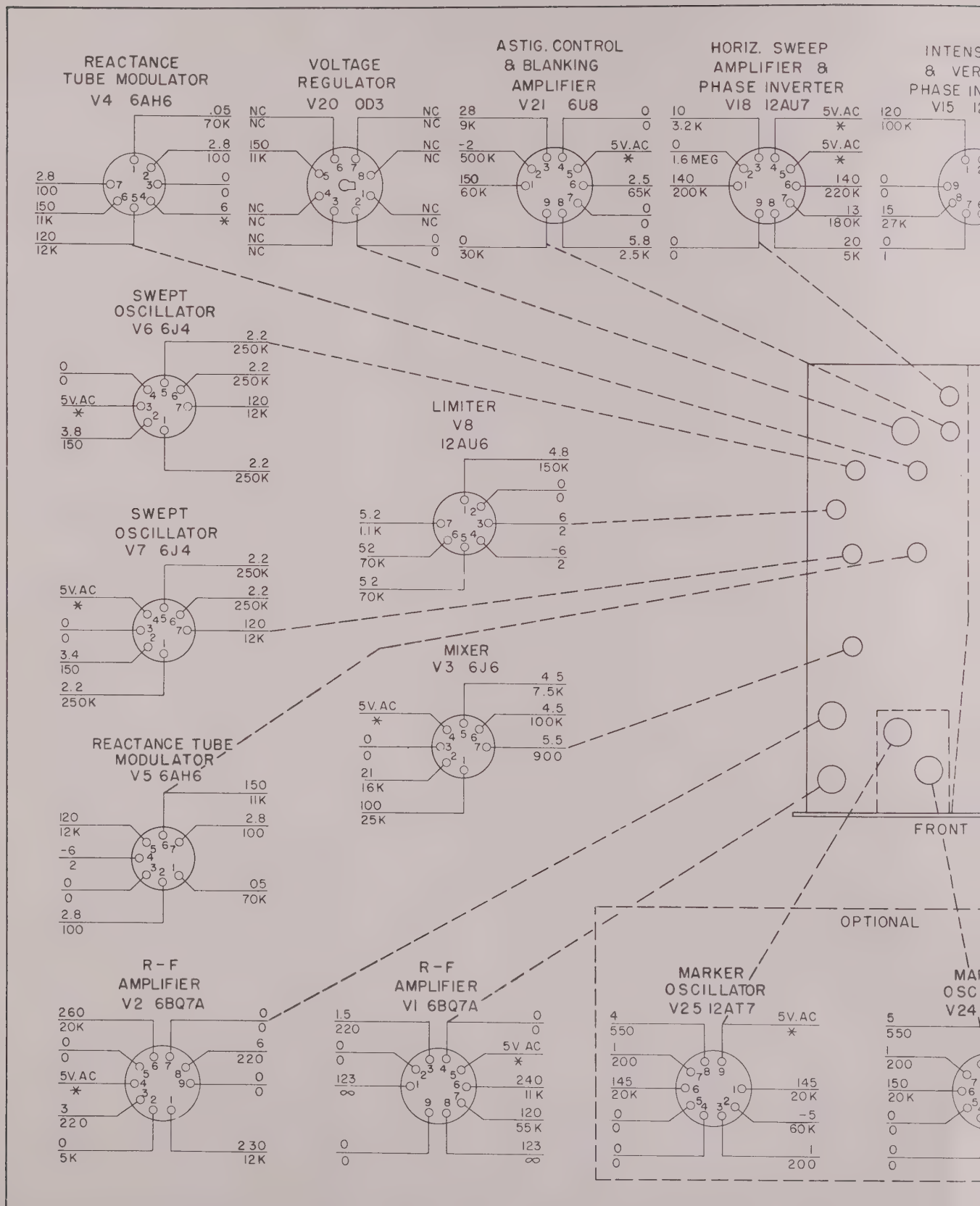
Control	Position
CAL-SYNC SEL.	Line
SYNC AMP	Normal
SWEEP WIDTH	1.0
SWEEP RATE	30 cycles
RESOLUTION	1.0
CENTER FREQ	At marker
AMPLITUDE SCALE	LIN
INTENSIFIER	Counterclockwise
FOCUS	Normal
BRILLIANCE	Normal
GAIN	Clockwise
MARKER AMP	Clockwise
MARKER BAL.	Clockwise
DIMMER	Clockwise
DIFFERENTIAL MARKERS	Center of dial
VIDEO FILTER	OUT

WARNING

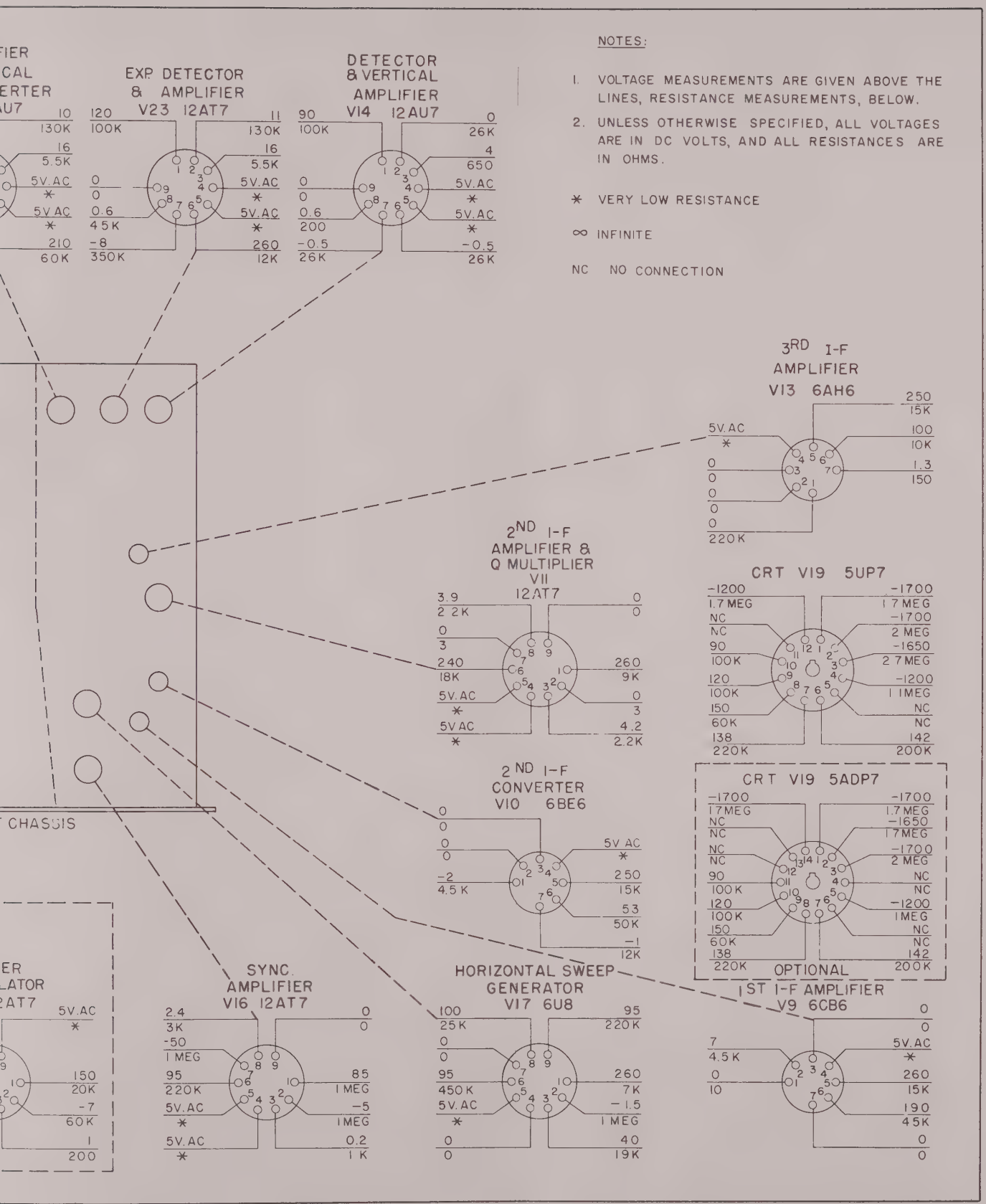
A +1800 volt potential exists on the crt anode cap when a type 5ADP7 cathode-ray tube is supplied with the equipment.



Tube Locattion Diagram and Voltage and Resistance Chart, Preamplifier, Model DA-1.


REACTANCE TUBE MODULATOR V4 6AH6
VOLTAGE REGULATOR V20 0D3
ASTIG. CONTROL & BLANKING AMPLIFIER V21 6U8
HORIZ. SWEEP AMPLIFIER & PHASE INVERTER V18 12AU7
SWEPT OSCILLATOR V6 6J4
SWEPT OSCILLATOR V7 6J4
LIMITER V8 12AU6
MIXER V3 6J6
REACTANCE TUBE MODULATOR V5 6AH6
R-F AMPLIFIER V2 6BQ7A
R-F AMPLIFIER V1 6BQ7A
MARKER OSCILLATOR V25 12AT7
OPTIONAL
FRONT

Tube Location Diagram and Voltage and Resistance Chart, Panoramic Indicator, SC-8b.


NOTES:
1. VOLTAGE MEASUREMENTS ARE GIVEN ABOVE THE LINES, RESISTANCE MEASUREMENTS, BELOW.
2. UNLESS OTHERWISE SPECIFIED, ALL VOLTAGES ARE IN DC VOLTS, AND ALL RESISTANCES ARE IN OHMS.
* VERY LOW RESISTANCE
∞ INFINITE
NC NO CONNECTION
EXP DETECTOR & AMPLIFIER V23 12AT7
DETECTOR & VERTICAL AMPLIFIER V14 12AU7
3RD I-F AMPLIFIER V13 6AH6
2ND I-F AMPLIFIER & Q MULTIPLIER V11 12AT7
CRT V19 5UP7
2ND I-F CONVERTER V10 6BE6
CRT V19 5ADP7
OPTIONAL
SYNC. AMPLIFIER V16 12AT7
HORIZONTAL SWEEP GENERATOR V17 6U8
1ST I-F AMPLIFIER V9 6CB6
CHASSIS

V-6. LIST OF REPLACEABLE PARTS

The following list of replaceable parts for the Panoramic Indicator, Model SC-8b, is divided into three individual sections. Each section contains the replaceable parts for an individual equipment unit. In cases where an item appears more than once, the total quantity in the entire section is listed only the first time the item appears. Immediately following the parts list is a legend of code letters used to designate the manufacturers' names. Values and ratings of components are nominal, and variations may exist in some equipments. In cases where variations occur, use the exact replacement of the component actually found in the equipment. When ordering parts from the factory, always include the following information: Instrument model number, serial number, Panoramic part number, and part description.

LIST OF REPLACEABLE PARTS FOR MODEL SC-8b

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn	Unit Price
C1		CAPACITOR: fixed, paper, tubular, molded plastic, .01 uf, 600 vdc. Pan Part CT1038-1	BD 6TM-S1	1		
C2		CAPACITOR: fixed, paper, tubular, molded plastic, .047 uf, 400 wdc. Pan Part CT1285-1	BD 4TM-S47	1		
C3		CAPACITOR: fixed, foil mica, 2700 uuf, ±10%. Pan Part CM30B272K	AP CM30B272K	2		
C4		CAPACITOR: fixed, silvered mica, 10 uuf, ±5%. Pan Part CM20C100J	AP CM20C100J	1		
C5		CAPACITOR: fixed, paper, tubular, molded plastic, .03 uf, 600 vdc. Pan Part CT2010-1	BD 6TM-S3	1		
C6 A,B, C,D		CAPACITOR: electrolytic, twistlock, 4 x 20 uf, 450 vdc. Pan Part CE34X200R-1	BC DFP	1		
C7		CAPACITOR: fixed, ceramic, disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	23		
C8		CAPACITOR: fixed, ceramic, disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C9		CAPACITOR: fixed, ceramic, disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C10		CAPACITOR: fixed, silvered mica, 5100 uuf, ±5%. Pan Part CM35C512J	AP CM35C512J	1		
C11		CAPACITOR: fixed, silvered mica, 91 uuf, ±5%. Pan Part CM20C910J	AP CM20C910J	1		
C12		CAPACITOR: fixed, paper, tubular, molded plastic, .02 uf, 400 vdc. Pan Part CT2073-1	BC 109P-22304	1		
C13		CAPACITOR: fixed, paper, oil filled, cylindrical, screw neck mounting, 8 uf, 600 vdc. Pan Part CP41C1XF805K-7	AV 6GA800	1		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn	Unit Price
C14		CAPACITOR: fixed, silver mica, 24 uuf, ±5%. Pan Part CM20C240J	AP CM20C240J	1		
C15		CAPACITOR: fixed, paper, tubular, oil filled, axial leads, .03 uf, 3000 vdc. Pan Part CT2104-3	AA 3089M	2		
C16		CAPACITOR: fixed, paper, tubular, molded plastic, .1 uf, 400 vdc. Pan Part CT2011-10	BB 330401	2		
C17		CAPACITOR: fixed, silvered mica, 510 uuf, ±5%. Pan Part CM20C511J	AP CM20C511J	4		
C18		CAPACITOR: fixed, paper, tubular, oil filled, axial leads, .03 uf, 3000 vdc. Pan Part CT2104-3	AA 3089M	-		
C19		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C21		CAPACITOR: fixed, silvered mica, 1000 uuf, ±5%. Pan Part CM25C102J	AP CM25C102J	1		
C22		CAPACITOR: fixed, paper, tubular, molded plastic, .1 uf, 400 vdc. Pan Part CT2011-10	BB 330401	-		
C25		CAPACITOR: fixed, silvered mica, 75 uuf, ±5%. Pan Part CM20C750J	AP CM20C750J	2* 1**		
C26		CAPACITOR: fixed, paper, tubular, molded plastic, .25 uf, 400 vdc. Pan Part CT2024-4	AM 4P25	-		
C28		CAPACITOR: electrolytic, twistlock, 2000 uf, 15 vdc. Pan Part CE31X202E-1	BD TVL-1168	1		
C29		CAPACITOR: fixed, paper, tubular, molded plastic, .47 uf, 200 vdc. Pan Part CT2075-1	BD 2TM-P47	1		

* For equipment having serial numbers 23H116 and below, 24J141 and below.
** For equipment having serial numbers 23J117 and above, 24K142 and above.

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn	Unit Price
C700		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C701		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C702		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C703		CAPACITOR: fixed, silvered mica, 5 uuf, ±10%. Pan Part CM20C050K	AP CM20C050K	3		
C704		CAPACITOR: fixed, silvered mica, 15 uuf, ±5%. Pan Part CM20C150J	AP CM20C150J	2		
C705		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C706		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C707		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C708		CAPACITOR: fixed, silvered mica, 5 uuf, ±10%. Pan Part CM20C050K	AP CM20C050K	-		
C709		CAPACITOR: fixed, silvered mica, 15 uuf, ±5%. Pan Part CM20C150J	AP CM20C150J	-		
C710		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C711		CAPACITOR: fixed, composition, .68 uuf, ±20%. Pan Part CC2006-15	BE GA	1		
C712		CAPACITOR: fixed, silvered mica, 5 uuf, ±10%. Pan Part CM20C050K	AP CM20C050K	-		
C713		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn	Unit Price
C714		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C715		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C716		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C900		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C901		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C902		CAPACITOR: fixed, ceramic, insulated, .01 uf, 600 vdc. Pan Part CC1282-14	AG D6-106BC	6		
C903		CAPACITOR: fixed, ceramic, insulated, .01 uf, 600 vdc. Pan Part CC1282-14	AG D6-106BC	-		
C904		CAPACITOR: fixed, ceramic, insulated, .01 uf, 600 vdc. Pan Part CC1282-14	AG D6-106BC	-		
C905		CAPACITOR: fixed, ceramic, insulated, .01 uf, 600 vdc. Pan Part CC1282-14	AG D6-106BC	-		
C906		CAPACITOR: fixed, ceramic, insulated, .01 uf, 600 vdc. Pan Part CC1282-14	AG D6-106BC	-		
C907		CAPACITOR: fixed, ceramic, 20 uuf, ±2%, 600 vdc, type NPO. Pan Part CC1105-14	AG TCZ-20	2		
C908		CAPACITOR: fixed, silvered mica, 51 uuf, ±5%. Pan Part CM20C510J	AP CM20C510J	2		
C909		CAPACITOR: fixed, ceramic, 20 uuf, ±2%, 600 vdc, type NPO. Pan Part CC1105-14	AG TCZ-20	-		
C910		CAPACITOR: fixed, silvered mica, 51 uuf, ±5%. Pan Part CM20C510J	AP CM20C510J	-		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn	Unit Price
C911		CAPACITOR: fixed, silvered mica, 82 uuf, ±5%. Pan Part CM20C820J	AP CM20C820J	1		
C912		CAPACITOR: fixed, foil mica, 2700 uuf, ±10%. Pan Part CM30B272K	AP CM30B272K	-		
C913		CAPACITOR: fixed, silvered mica, 470 uuf, ±5%. Pan Part CM20C471J	AP CM20C471J	1		
C914		CAPACITOR: fixed, ceramic, insulated, .01 uf, 600 vdc. Pan Part CC1282-14	AG D6-106BC	-		
C915		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C916		CAPACITOR: fixed, silvered mica, 100 uuf, ±5%. Pan Part CM20C101J	AP CM20C101J	5		
C917		CAPACITOR: fixed, silvered mica, 100 uuf, ±5%. Pan Part CM20C101J	AP CM20C101J	-		
C918		CAPACITOR: fixed, ceramic disc, .05 uf, 500 vdc. Pan Part CC2123-1	BC 41C105	2		
C919		CAPACITOR: fixed, ceramic disc, .05 uf, 500 vdc. Pan Part CC2123-1	BC 41C105	-		
C927		CAPACITOR: fixed, silvered mica, 100 uuf, ±5%. Pan Part CM20C101J	AP CM20C101J	-		
C940		CAPACITOR: air-trimmer, dual, variable, 7-45 uuf per section. Pan Part CV2052	AQ TD-2A7	4		
C941		CAPACITOR: air-trimmer, dual, variable, 7-45 uuf, per section. Pan Part CV2052	AQ TD-2A7	-		
C942		CAPACITOR: variable, air, dual differential, 10-108 uuf per section. Pan Part CV2066	AZ CV2066	1		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn	Unit Price
C943		CAPACITOR: air-trimmer, dual, variable, 7-45 uuf per section. Pan Part CV2052	AQ TD-2A7	-		
C944		CAPACITOR: fixed, silvered mica, 68 uuf, ±5%. Pan Part CM20C680J	AP CM20C680J	2		
C945		CAPACITOR: fixed, silvered mica, 30 uuf, ±5%. Pan Part CM20C300J	AP CM20C300J	2		
C946		CAPACITOR: air-trimmer, dual, variable, 7-45 uuf per section. Pan Part CV2052	AQ TD-2A7	-		
C947		CAPACITOR: fixed, silvered mica, 30 uuf, ±5%. Pan Part CM20C300J	AP CM20C300J	-		
C948		CAPACITOR: fixed, silvered mica, 68 uuf, ±5%. Pan Part CM20C680J	AP CM20C680J	-		
C949		CAPACITOR: fixed, silvered mica, 100 uuf, ±5%. Pan Part CM20C101J	AP CM20C101J	-		
C950		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C951		CAPACITOR: fixed, silvered mica, 100 uuf, ±5%. Pan Part CM20C101J	AP CM20C101J	-		
C952		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C953		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C960		CAPACITOR: fixed, mica, 10,000 uuf, ±10%. Pan Part CM35B103K	AP CM35B103K	2		
C961		CAPACITOR: fixed, mica, 10,000 uuf, ±10%. Pan Part CM35B103K	AP CM35B103K	-		
C962		CAPACITOR: fixed, silvered mica, 270 uuf, ±5%. Pan Part CM15E271J	AP CM15E271J	2		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn	Unit Price
C963		CAPACITOR: fixed, paper, oil-filled, 2 x .25 uf, +20%, -10%, 600 vdc. Pan Part CP69B4EF254V-1	BD CP69B4 EF254V	1		
C964		CAPACITOR: fixed, ceramic, insulated, 100 uuf, ±10%, 600 vdc. Pan Part CC1088a-14	AG DB-101BC	5		
C965		CAPACITOR: fixed, silvered mica, 270 uuf, ±5%. Pan Part CM15E271J	AP CM15E271J	-		
C966		CAPACITOR: fixed, ceramic insulated, 100 uuf, ±10%. 600 vdc. Pan Part CC1088a-14	AG DB-101BC			
C967		CAPACITOR: fixed, ceramic, insulated, 100 uuf, ±10%, 600 vdc. Pan Part 1088a-14	AG DB-101BC	-		
C968		CAPACITOR: fixed, ceramic, insulated, 100 uuf, ±10%, 600 vdc. Pan Part CC1088a-14	AG DB-101BC	-		
C969		CAPACITOR: fixed, silvered mica, 510 uuf, ±5%. Pan Part CM20C511J	AP CM20C511J	-		
C970		CAPACITOR: fixed, ceramic, insulated, 100 uuf, ±10%, 600 vdc. Pan Part CC1088a-14	AG DB-101BC	-		
C971		CAPACITOR: fixed, silvered mica, 510 uuf, ±5%. Pan Part CM20C511J	AP CM20C511J	-		
C972		CAPACITOR: fixed, silvered mica, 510 uuf, ±5%. Pan Part CM20C511J	AP CM20C511J	-		
C973		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C974		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C980		CAPACITOR: fixed, silvered mica, 75 uuf, ±5%. Pan Part CM20C750J	AP CM20C750J	-*		

* Used in equipment having serial numbers 23H116 and below, 24J141 and below.

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn	Unit Price
C980 cont'd		CAPACITOR: fixed, silvered mica, 47 uuf, ±5%. Pan Part CM15C470J	AP CM15C470J	1**		
CR1		RECTIFIER: selenium, bridge type. Pan Part CR2010	BA 16S1B1SIG	1		
CR2		DIODE: germanium, 1N81A. Pan Part CR-1N81A	BA 1N81A	1		
CR960		DIODE: germanium, 1N34A. Pan Part CR-1N34A	BA 1N34A	1		
I1		PILOT LAMP: miniature bayonet, 6.3 vac, .15 A. Pan Part B1007	AN 47	6		
I2		PILOT LAMP: miniature bayonet, 6.3 vac, .15 A. Pan Part B1007	AN 47	-		
I3		PILOT LAMP: miniature bayonet, 6.3 vac, .15A. Pan Part B1007	AN 47	-		
I4		PILOT LAMP: miniature bayonet, 6.3 vac, .15 A. Pan Part B1007	AN 47	-		
I5		PILOT LAMP: miniature bayonet, 6.3 vac, .15 A. Pan Part B1007	AN 47	-		
I6		PILOT LAMP: miniature bayonet, 6.3 vac, .15A. Pan Part B1007	AN 47	-		
I10		LAMP: neon, double contact, bayonet, candelabra base, special type NE-16. Pan Part B2026-M	AZ B2026-M	1		
J10		CONNECTOR: receptacle, 14 contact, male, solid shell. Pan Part P2006	AD MS-3102 A -28-2P	1		
J101		CONNECTOR: receptacle, r-f, Series N. Pan Part J1061	AD 82-24	2		
J103		CONNECTOR: receptacle, 1 contact, female. Pan Part J2010	AD 31-003	1		

** Used in equipment having serial numbers 23J117 and above, 24K142 and below.

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn	Unit Price
J105		CONNECTOR: receptacle, miniature, 5 contact, female. Pan Part J2018	AL C520SVRN	1		
L701		COIL: choke, r-f, 6 turns, #20 E wire, closewound. Pan Part L1-11550-1	AZ L1-11550-1	1		
L702		CHOKE: radio frequency, special. Pan Part L1-11555	AZ L1-11555	1		
L703		CHOKE: radio frequency, special. Pan Part L1-115500-1	AZ L1-11550-1	1		
L940		COIL: oscillator, 30-35 MC. Pan Part ZN8368	AZ ZN8368	1		
L941		COIL: oscillator, 25-30 MC. Pan Part ZN8369	AZ ZN8369	1		
L960		CHOKE: r-f, ferrite core, 100 uh. Pan Part L1112	BF CH-3-3	2		
L961		CHOKE: r-f, ferrite core, 100 uh. Pan Part L1112	BF CH-3-3	-		
L962		CHOKE: r-f. Pan Part L1-11550-2	AZ L1-11550-2	1		
L980		COIL: filter. Pan Part ZN8328	AZ ZN8328	1		
LA		COIL: r-f, trap. Pan Part ZN8267	AZ ZN8267	2		
LB		COIL: r-f, trap. Pan Part ZN8267	AZ ZN8267	-		
P105		CONNECTOR: r-f, 1 pin BNC. Pan Part P2010	AD 31-012	1		
P106		CONNECTOR: plug miniature, 5 contact, male. Pan Part P2024	AL C5-20PV S/38	1		
R1		RESISTOR: fixed, composition, 620 ohms, ±5%, 1/2 W. Pan Part RC20BX621J	AC EB6215	1		
R2		RESISTOR: fixed, composition, 120 ohms, ±5%, 1/2 W. Pan Part RC20BX121J	AC EB1215	1		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn	Unit Price
R4		RESISTOR: fixed, composition, 4.7 megohms, ±5%, 1/2 W. Pan Part RC20BX475J	AC EB4755	1		
R5		RESISTOR: fixed, composition, 1 megohm, ±5%, 1/2 W. Pan Part RC20BX105J	AC EB1055	4		
R6		RESISTOR: fixed, composition, 1.2 megohms, ±5%, 1/2 W. Pan Part RC20BX125J	AC EB1255	1		
R7		RESISTOR: fixed, composition, 220,000 ohms, ±5%, 1/2 W. Pan Part RC20BX224J	AC EB2245	10		
R8		RESISTOR: fixed, composition, 160,000 ohms, ±5%, 1/2 W. Pan Part RC20BX164J	AC EB1645	1		
R9		RESISTOR: fixed, composition, 5,600 ohms, ±5%, 1/2 W. Pan Part RC20BX562J	AC EB5625	5		
R10		RESISTOR: fixed, composition, 27,000 ohms, ±5%, 1/2 W. Pan Part RC20BX273J	AC EB2735	1		
R11		RESISTOR: variable, composition, linear, 500,000 ohms, ±10%, 2 W. Pan Part RVA504AQ-2J	AC JU5041	3		
R12		RESISTOR: fixed, composition, 68,000 ohms, ±5%, 1 W. Pan Part RC32BX683J	AC GB6835	2		
R13		RESISTOR: variable, composition, linear, 500,000 ohms, ±10%, 2 W. Pan Part RVA504AQ-2J	AC JU5041	-		
R14		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1/2 W. Pan Part RC20BX104J	AC EB1045	6		
R15		RESISTOR: fixed, composition, 1 megohm, ±5%, 1/2 W. Pan Part RC20BX105J	AC EB1055	-		
R16		RESISTOR: fixed, composition, 1000 ohms, ±5%, 1/2 W. Pan Part RC20BX102J	AC EB1025	7		
R17		RESISTOR: fixed, composition, 1 megohm, ±5%, 1/2 W. Pan Part RC20BX105J	AC EB1055	-		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn	Unit Price
R18		RESISTOR: fixed, composition, 220,000 ohms, ±5%, 1/2 W. Pan Part RC20BX224J	AC EB2245	-		
R19		RESISTOR: fixed, composition, 100 ohms, ±5%, 1/2 W. Pan Part RC20BX101J	AC EB1015	1		
R20		RESISTOR: fixed, composition, 1 megohm, ±5%, 1/2 W. Pan Part RC20BX105J	AC EB1055	-		
R21		RESISTOR: fixed, composition, 3,000 ohms, ±5%, 1/2 W. Pan Part RC20BX302J	AC EB3025	1		
R22		RESISTOR: variable, composition, linear, 50,000 ohms, ±10%, 2 W. Pan Part RVA503AQ-2J	AC JU5031	3		
R23		RESISTOR: fixed, composition, 820,000 ohms, ±5%, 1/2 W. Pan Part RC20BX824J	AC EB8245	1		
R24 A,B		RESISTOR: variable, composition, linear, dual, 50,000 ohms, 5 megohms, ±20%, 2 W. Pan Part RVB503/505BQ-2J	AC JJU-5032/ 5052	1		
R25		RESISTOR: fixed, composition, 3,300 ohms, ±5%, 1 W. Pan Part RC32BX332J	AC GB3325	1		
R26		RESISTOR: fixed, composition, 20,000 ohms, ±5%, 1/2 W. Pan Part RC20BX203J	AC EB2035	4		
R27		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1 W. Pan Part RC32BX104J	AC GB1045	5		
R28		RESISTOR: fixed, composition, 470,000 ohms, ±5%, 1/2 W. Pan Part RC20BX745J	AC EB4745	2		
R29		RESISTOR: fixed, composition, 15,000 ohms, ±5%, 1 W. Pan Part RC32BX153J	AC GB1535	3		
R30		RESISTOR: fixed, composition, 10,000 ohms, ±5%, 1 W. (nominal value, see schematic diagram) Pan Part RC32BX103J	AC GB103J	1		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.	Unit Price
R31		RESISTOR: fixed, composition, 240,000 ohms, ±5%, 1/2 W. Pan Part RC20BX244J	AC EB2245	-		
R32		RESISTOR: variable, composition, linear, 2 megohms, ±20%, 2 W. Pan Part RVA205BQ-2J	AC JU2052	1		
R33		RESISTOR: variable, composition, 100,000 ohms, ±10% ±10%, 2 W. Pan Part RV-A1-11124	AC J81071/ SD3056	1		
R34		RESISTOR: fixed, composition, 5.6 megohms, ±5%, 1/2 W. Pan Part RC20BX565J	AC EB5655	1		
R35		RESISTOR: variable, composition, linear, 500,000 ohms ohms, ±10%, 2 W. Pan Part RVA504AQ-2J	AC JU5041	-		
R36		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1 W. Pan Part RC32BX104J	AC GB1045	-		
R37		RESISTOR: fixed, composition, 220,000 ohms, ±5%, 1/2 W. Pan Part RC20BX224J	AC EB2245	-		
R38		RESISTOR: fixed, composition, 220,000 ohms, ±5%, 1/2 W. Pan Part RC20BX224J	AC EB2245	-		
R39		RESISTOR: fixed, composition, 75,000 ohms, ±5%, 2 W. Pan Part RC42BX753J	AC HB7535	1		
R40		RESISTOR: variable, composition, linear, 5,000 ohms, ±10%, 2 W. Pan Part RVA502AQ-2J	AC JU5021	3		
R41		RESISTOR: fixed, composition, 2.2 megohms, ±5%, 1/2 W. Pan Part RC20BX225J	AC EB2255	1		
R42		RESISTOR: fixed, composition, 1,000 ohms, ±5%, 1/2 W. Pan Part RC20BX102J	AC EB1025	-		
R43		RESISTOR: fixed, composition, 10,000 ohms, ±5%, 1/2 W. Pan Part RC20BX103J	AC EB1035	7		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn	Unit Price
R44		RESISTOR: fixed, composition, 5,600 ohms, ±5%, 1/2 W. Pan Part RC20BX562J	AC EB5625	-		
R45		RESISTOR: fixed, composition, 1.8 megohms, ±5%, 1/2 W. Pan Part RC20BX185J	AC EB1855	1		
R46		RESISTOR: fixed, composition, 180,000 ohms, ±5%, 1/2 W. Pan Part RC20BX184J	AC EB1845	1		
R47		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1 W. Pan Part RC32BX104J	AC GB1045	-		
R48		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1 W. Pan Part RC32BX104J	AC GB1045	-		
R49		RESISTOR: fixed, composition, 470,000 ohms, ±5%, 1 W. Pan Part RC32BX474J	AC GB4745	2		
R50		RESISTOR: fixed, composition, 470,000 ohms, ±5%, 1 W. Pan Part RC32BX474J	AC GB4745	-		
R51		RESISTOR: variable, composition, linear, 500,000 ohms, 2000 V, 1/2 W. Pan Part RVAH504B1-3	AK CM8339	2		
R52		RESISTOR: fixed, composition, 270,000 ohms, ±5%, 1 W. Pan Part RC32BX274J	AC GB2745	1		
R53		RESISTOR: variable, composition, linear, 100,000 ohms, 2000 V, 1/2 W. Pan Part RVAH504B1-3	AK CM8339	-		
R54		RESISTOR: fixed, composition, 390,000 ohms, ±5%, 1 W. Pan Part RC32BX394J	AC GB3945	1		
R55		RESISTOR: fixed, composition, 20,000 ohms, ±5%, 1/2 W. Pan Part RC20BX203J (nominal value, see schematic diagram)	AC EB2035	-		
R56		RESISTOR: fixed, composition, 56,000 ohms, ±5%, 1/2 W. Pan Part RC20BX563J	AC EB5635	6		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn	Unit Price
R57		RESISTOR: fixed, composition, 47,000 ohms, ±5%, 1 W. Pan Part RC32BX473J	AC GB4735	2		
R58		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1 W. Pan Part RC20BX104J	AC EB1045	-		
R59		RESISTOR: fixed, composition, 51,000 ohms, ±5%, 1/2 W. Pan Part RC20BX513J	AC EB5135	2		
R60		RESISTOR: fixed, composition, 220,000 ohms, ±5%, 1/2 W. pan Part RC20BX224J	AC EB2245	-		
R61		RESISTOR: variable, composition, linear, 5,000 ohms, ±10%, 2 W. Pan Part RVA502AQ2J	AC JU5021	-		
R62		RESISTOR: fixed, composition, 10,000 ohms, ±5%, 1/2 W. Pan Part RC20BX103J	AC EB1035	-		
R63		RESISTOR: fixed, composition, 470,000 ohms, ±5%, 1/2 W. Pan Part RC20BX474J	AC EB4745	-		
R64		RESISTOR: fixed, composition, 2,200 ohms, ±5%, 1/2 W. Pan Part RC20BX222J	AC EB2225	5		
R65		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1/2 W. Pan Part RC20BX104J	AC EB1045	-		
R66		RESISTOR: fixed, composition, 150,000 ohms, ±5%, 1/2 W. Pan Part RC20BX154J	AC EB1545	1		
R67		RESISTOR: fixed, composition, 220,000 ohms, ±5%, 1/2 W. Pan Part RC20BX224J	AC EB2245	-		
R68		RESISTOR: fixed, composition, 4,700 ohms, ±5%, 1/2 W. Pan Part RC20BX472J	AC EB4725	1		
R69		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1/2 W. (nominal value, see schematic diagram) Pan Part RC20BX104J	AC 1045	-		
R70		RESISTOR: fixed, composition, 680,000 ohms, ±5%, 1/2 W. Pan Part RC20BX684J	AC EB6845	1		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn	Unit Price
R71		RESISTOR: fixed, composition, 2,200 ohms, ±5%, 1/2 W. (nominal value, see schematic diagram) Pan Part RC20BX222J	AC EB2225	-		
R72		RESISTOR: fixed, composition, 2,200 ohms, ±5%, 1/2 W. Pan Part RC20BX222J	AC EB2225	-		
R73		RESISTOR: fixed, composition, 220,000 ohms, ±5%, 1/2 W. Pan Part RC20BX224J	AC EB2245	-		
R74		RESISTOR: fixed, composition, 33,000 ohms, ±5%, 1/2 W. Pan Part RC20BX333J	AC EB3335	1		
R75		RESISTOR: variable, wire wound, (includes S12, SPST switch attached) 6 ohms, 2 W. Pan Part RVW060B1-1-S1	AI GC252	1		
		or				
		RESISTOR: variable, wire wound (includes S12, SPST switch attached) 20 ohms, 2 W. Pan Part RVW200B1-1-S1	AX W20+51	1		
R700		RESISTOR: fixed, composition, 51 ohms, ±5%, 1/2 W. Pan Part RC20BX510J	AC EB5105	4		
R701		RESISTOR: fixed, composition, 220 ohms, ±5%, 1/2 W. Pan Part RC20BX221J	AC EB2215	8		
R702		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1/2 W. Pan Part RC20BX104J	AC EB1045	-		
R703		RESISTOR: variable, composition, linear, 5,000 ohms, ±10%, 2 W. Pan Part RVA502AQ-2J	AC JU-5021	-		
R704		RESISTOR: fixed, composition, 18,000 ohms, ±5%, 1/2 W. Pan Part RC20BX183J	AC EB1835	1		
R705		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1/2 W. Pan Part RC20BX104J	AC EB1045	-		
R706		RESISTOR: fixed, composition, 2,200 ohms, ±5%, 1 W. Pan Part RC32BX222J	AC EB2225	-		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn	Unit Price
R707		RESISTOR: fixed, composition, 8,200 ohms, ±5%, 1/2 W. (nominal value, see schematic diagram) Pan Part RC20BX822J	AC 8225	1		
R708		RESISTOR: fixed, composition, 1,000 ohms, ±5%, 1/2 W. Pan Part RC20BX102J	AC EB1025	-		
R709		RESISTOR: fixed, composition, 220 ohms, ±5%, 1/2 W. Pan Part RC20BX221J	AC EB2215	-		
R710		RESISTOR: fixed, composition, 220 ohms, ±5%, 1/2 W. Pan Part RC20BX221J	AC EB2215	-		
R711		RESISTOR: fixed, wirewound, insulated, 10,000 ohms, 5 W. Pan Part RW5X103R-4	BI "Vitrohm" 5F10,000WL	1		
R712		RESISTOR: fixed, composition, 51 ohms, ±5%, 1/2 W. Pan Part RC20BX510J	AC EB5105	-		
R713		RESISTOR: fixed, composition, 3,300 ohms, ±5%, 1/2 W. Pan Part RC20BX332J	AC EB3325	1		
R714		RESISTOR: fixed, composition, 5,600 ohms, ±5%, 1/2 W. Pan Part RC20BX562J	AC EB5625	-		
R715		RESISTOR: fixed, composition, 1,000 ohms, ±5%, 1/2 W. Pan Part RC20BX102J	AC EB1025	-		
R716		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1/2 W. Pan Part RC20BX104J	AC EB1045	-		
R717		RESISTOR: fixed, composition, 15,000 ohms, ±5%, 1/2 W. Pan Part RC20BX153J	AC EB1535	1		
R718		RESISTOR: fixed, composition, 47,000 ohms, ±5%, 1/2 W. Pan Part RC20BX473J	AC EB4735	3		
R719		RESISTOR: fixed, composition, 56,000 ohms, ±5%, 1/2 W. Pan Part RC20BX563J	AC EB5635	-		
R720		RESISTOR: fixed, composition, 47,000 ohms, ±5%, 1 W. Pan Part RC32BX473J	AC GB4735	-		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn	Unit Price
R721		RESISTOR: fixed, composition, 47,000 ohms, ±5%, 1 W. Pan Part RC32BX473J	AC GB4735	-		
R722		RESISTOR: fixed, composition, factory selected. (see schematic diagram)	-	-		
R900		RESISTOR: fixed, composition, 10 ohms, ±5%, 1/2 W. Pan Part RC20BX100J	AC EB1005	1		
R901		RESISTOR: fixed, composition, 47 ohms, ±5%, 1/2 W. Pan Part RC20BX470J	AC EB4705	1		
R902		RESISTOR: fixed, composition, 150,000 ohms, ±5%, 1 W. Pan Part RC32BX154J	AC GB1545	1		
R903		RESISTOR: variable, composition, 5,000 ohms, ±10%, 2 W. B taper. Pan Part RVA502EQ-2J	AC JB5021	1		
R904		RESISTOR: fixed, composition, 150 ohms, ±5%, 1/2 W. Pan Part RC20BX151J	AC EB1515	2		
R905		RESISTOR: fixed, composition, 47,000 ohms, ±5%, 1 W. Pan Part RC32BX473J	AC GB4735	-		
R906		RESISTOR: fixed, composition, 5,600 ohms, ±5%, 1/2 W. Pan Part RC20BX562J	AC EB5625	-		
R907		RESISTOR: fixed, composition, 10,000 ohms, ±5%, 1/2 W. Pan Part RC20BX103J	AC EB1035	-		
R908		RESISTOR: fixed, composition, 1,300 ohms, ±5%, 1/2 W. Pan Part RC20BX132J	AC EB1325	1		
R909		RESISTOR: fixed, composition, 5,600 ohms, ±5%, 1/2 W. Pan Part RC20BX562J	AC EB5625	-		
R910 A,B,C		RESISTOR: variable, triple tandem, composition, C taper 100 K-100K-5K, ±20%, 1/4 W. Pan Part RVB104/104/502F 1-1-P1-W2	AI Type 3-45	1		
R911		RESISTOR: fixed, composition, 75,000 ohms, ±5%, 1 W. Pan Part RC32BX753J	AC GB7535	2		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn	Unit Price
R912		RESISTOR: fixed, composition, 75,000 ohms, ±5%, 1 W. Pan Part RC32BX753J	AC GB7535	-		
R914		RESISTOR: fixed, composition, 1,200 ohms, ±5%, 1/2 W. Pan Part RC20BX122J	AC EB1225	1		
R915		RESISTOR: fixed, composition, 10,000 ohms, ±5%, 1/2 W. Pan Part RC20BX103J	AC EB1035	-		
R916		RESISTOR: fixed, composition, 2,200 ohms, ±5%, 1/2 W. Pan Part RC20BX222J	AC EB2225	-		
R917		RESISTOR: fixed, composition, 2,200 ohms, ±5%, 1/2 W. Pan Part RC20BX222J	AC EB2225	-		
R918		RESISTOR: fixed, composition, 220,000 ohms, ±5%, 1/2 W. Pan Part RC20BX224J	AC EB2245	-		
R919		RESISTOR: fixed, composition, 150 ohms, ±5%, 1/2 W. Pan Part RC20BX151J	AC EB1515	-		
R920		RESISTOR: fixed, composition, 68,000 ohms, ±5%, 1/2 W. Pan Part RC20BX683J	AC EB6835	1		
R921		RESISTOR: variable, composition, linear, 50,000 ohms, ±10%, 2 W. Pan Part RVA503AQ-2J	AC JU5031	-		
R922		RESISTOR: fixed, composition, 15,000 ohms, ±5%, 1 W. Pan Part RC32BX153J	AC GB1535	-		
R923		RESISTOR: fixed, composition, 15,000 ohms, ±5%, 1 W. Pan Part RC32BX153J	AC GB1535	-		
R924		RESISTOR: fixed, composition, 16,000 ohms, ±5%, 1 W. Pan Part RC32BX163J	AC GB1635	1		
R925		RESISTOR: fixed, composition, 22,000 ohms, ±5%, 2 W. Pan Part RC42BX223J	AC HB2235	1		
R926		RESISTOR: fixed, composition, 5,600 ohms, ±5%, 1 W. Pan Part RC32BX562J	AC GB5625	1		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn	Unit Price
R927		RESISTOR: variable, composition, linear, 50,000 ohms, ±10%, 2 W. Pan Part RVA503AQ-2J	AC JU5031	-		
R928		RESISTOR: fixed, composition, 51,000 ohms, ±5%, 1/2 W. Pan Part RC20BX513J	AC EB5135	-		
R929		RESISTOR: fixed, composition, 68,000 ohms, ±5%, 1 W. Pan Part RC32BX683J	AC GB6835	-		
R940		RESISTOR: fixed, composition, 56,000 ohms, ±5%, 1/2 W. Pan Part RC20BX563J	AC EB5635	-		
R941		RESISTOR: fixed, composition, 220 ohms, ±5%, 1/2 W. Pan Part RC20BX221J	AC EB2215	-		
R942		RESISTOR: fixed, composition, 1,000 ohms, ±5%, 1/2 W. Pan Part RC20BX102J	AC EB1025	-		
R943		RESISTOR: fixed, composition, 220 ohms, ±5%, 1/2 W. Pan Part RC20BX221J	AC EB2215	-		
R944		RESISTOR: fixed, composition, 10,000 ohms, ±5%, 2 W. Pan Part RC42BX103J	AC HB1035	2		
R945 A,B		RESISTOR: variable, composition, dual, concentric, 1,000 - 500 ohms, ±20%, 1/2 W. Pan Part RVC102/501BK-1-S1	AI GC-C2-35	1		
R946		RESISTOR: fixed, composition, 10,000 ohms, ±5%, 2 W. Pan Part RC42BX103J	AC HB1035	-		
R947		RESISTOR: fixed, composition, 56,000 ohms, ±5%, 1/2 W. Pan Part RC20BX563J	AC EB5635	-		
R948		RESISTOR: fixed, composition, 220 ohms, ±5%, 1/2 W. Pan Part RC20BX221J	AC EB2215	-		
R949		RESISTOR: fixed, composition, 1,000 ohms, ±5%, 1/2 W. Pan Part RC20BX102J	AC EB1025	-		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty 3 Mo. Opn	Unit Price
R950		RESISTOR: fixed, composition, 220 ohms, ±5%, 1/2 W. Pan Part RC20BX221J	AC EB2215	-		
R951		RESISTOR: fixed, composition, 220 ohms, ±5%, 1/2 W. Pan Part RC20BX221J	AC EB2215	-		
R952		RESISTOR: fixed, composition, 10,000 ohms, ±5%, 1/2 W. (nominal value, see schematic diagram) Pan Part RC20BX103J	AC EB1035	-		
R953		RESISTOR: fixed, composition, 12 ohms, ±5%, 1/2 W. Pan Part RC20BX120J	AC EB1205	2		
R954		RESISTOR: fixed, composition, 12 ohms, ±5%, 1/2 W. Pan Part RC20BX120J	AC EB1205	-		
R960		RESISTOR: fixed, composition, 1,000 ohms, ±5%, 1/2 W. Pan Part RC20BX102J	AC EB1025	-		
R961		RESISTOR: fixed, composition, 56,000 ohms, ±5%, 1/2 W. Pan Part RC20BX563J	AC EB5635	-		
R962		RESISTOR: fixed, composition, 56,000 ohms, ±5%, 1/2 W. Pan Part RC20BX563J	AC EB5635	-		
R963		RESISTOR: fixed, composition, 240,000 ohms, ±5%, 1/2 W. Pan Part RC20BX244J	AC EB2445	2		
R964		RESISTOR: fixed, composition, 20,000 ohms, ±5%, 1/2 W. Pan Part RC20BX203J	AC EB2035	-		
R965		RESISTOR: fixed, composition, 240,000 ohms, ±5%, 1/2 W. Pan Part RC20BX244J	AC EB2445	-		
R966		RESISTOR: fixed, composition, 20,000 ohms, ±5%, 1/2 W. Pan Part RC20BX203J	AC EB2035	-		
R967		RESISTOR: fixed, composition, 51 ohms, ±5%, 1/2 W. Pan Part RC20BX510J	AC EB5105	-		
R968		RESISTOR: fixed, composition, 1,200 ohms, ±5%, 2 W. Pan Part RC42BX122J	AC HB1225	1		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty 3 Mo. Opn	Unit Price
R969		RESISTOR: fixed, composition, 510 ohms, ±5%, 1/2 W. Pan Part RC20BX511J	AC EB5115	2		
R970		RESISTOR: fixed, composition, 10,000 ohms, ±5%, 1/2 W. Pan Part RC20BX103J	AC EB1035	-		
R971		RESISTOR: fixed, composition, 10,000 ohms, ±5%, 1/2 W. Pan Part RC20BX103J	AC EB1035	-		
R972		RESISTOR: fixed, composition, 510 ohm, ±5%, 1/2 W. Pan Part RC20BX511J	AC EB5115	-		
R973		RESISTOR: fixed, composition, 51 ohms, ±5%, 1/2 W. Pan Part RC20BX510J	AC EB5105	-		
R975		RESISTOR: variable, composition, linear, 300 ohms, ±10%, 2 W. Pan Part RVA301AQ-2J	AC JU3011	2		
R976		RESISTOR: fixed, composition, 39 ohms, ±5%, 1 W. Pan Part RC32BX390J	AC GB3905	1		
R977		RESISTOR: variable, composition, linear, 300 ohms, ±10%, 2 W. Pan Part RVA301AQ-2J	AC JU3011	-		
R978		RESISTOR: fixed, composition, 560 ohms, ±5%, 1/2 W. Pan Part RC20BX561J	AC EB5615	1		
R980		RESISTOR: fixed, wirewound, insulated, 2,000 ohms, 10 W. Pan Part RW10X202R	BG FRL-10-2K	1		
S10 A,B, C		ROTARY SWITCH: 3 pole, 3 pos., 1 deck, ceramic. Pan Part S1-9395A	AZ S1-9395A	2		
S11 A,B, C		ROTARY SWITCH: 3 pole, 3 pos., 1 deck, ceramic. Pan Part S1-9395A	AZ S1-9395A	-		
S12		See R75.				
S13		ROTARY SWITCH: 1 pole, 3 pos., 1 wafer, bakelite. Pan Part S-1026-(13)	AZ S-1026-(13)	1		
S941		See R945				

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn	Unit Price
T101		TRANSFORMER: r-f, 30 MC, ±5 MC. Pan Part ZN8257	AZ ZN8257	1		
T102		TRANSFORMER: r-f 30MC±5 MC. Pan Part ZN8269	AZ ZN8269	1		
V1		ELECTRON TUBE: 6BQ7 Pan Part 6BQ7	BZ 6BQ7	2		
V2		ELECTRON TUBE: 6BQ7 Pan Part 6BQ7	BZ 6BQ7	-		
V3		ELECTRON TUBE: 6J6 Pan Part 6J6	BZ 6J6	1		
V4		ELECTRON TUBE: 6AH6 Pan Part 6AH6	BZ 6AH6	3		
V5		ELECTRON TUBE: 6AH6 Pan Part 6AH6	BZ 6AH6	-		
V6		ELECTRON: 6J4 Pan Part 6J4	BZ 6J4	2		
V7		ELECTRON: 6J4 Pan Part 6J4	BZ 6J4	-		
V8		ELECTRON TUBE: 12AU6 Pan Part 12AU6	BZ 12AU6	1		
V9		ELECTRON TUBE: 6CB6 Pan Part 6CB6	BZ 6CB6	1		
V10		ELECTRON TUBE: 6BE6 Pan Part 6BE6	BZ 6BE6	1		
V11		ELECTRON TUBE: 12AT7 Pan Part 12AT7	BZ 12AT7	5		
V13		ELECTRON TUBE: 6AH6 Pan Part 6AH6	BZ 6AH6	-		
V14		ELECTRON TUBE: 12AU7 Pan Part 12AU7	BZ 12AU7	3		
V15		ELECTRON TUBE: 12AU7 Pan Part 12AU7	BZ 12AU7	-		
V16		ELECTRON TUBE: 12AT7 Pan Part 12AT7	BZ 12AT7	-		
V17		ELECTRON TUBE: 6U8 Pan Part 6U8	BZ 6U8	2		
V18		ELECTRON TUBE: 12AU7 Pan Part 12AU7	BZ 12AU7	-		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn	Unit Price
V19		ELECTRON TUBE: cathode-ray, 5UP7 or 5ADP7 Pan Part 5UP7 or 5ADP7	BZ 5UP7 5ADP7	1		
V20		ELECTRON TUBE: OD3 Pan Part OD3	BZ OD3	1		
V21		ELECTRON TUBE: 6U8 Pan Part 6U8	BZ 6U8	-		
V23		ELECTRON TUBE: 12AT7 Pan Part 12AT7	BZ 12AT7	-		
V24		ELECTRON TUBE: 12AT7 Pan Part 12AT7	BZ 12AT7	-		
V25		ELECTRON TUBE: 12AT7 Pan Part 12AT7	BZ 12AT7	-		
Z101		TRANSFORMER: r-f oscillator coil, 53 MC ± 5 MC	AZ ZN8259	1		
Z102		TRANSFORMER: r-f 23 MC Pan Part ZN8260	AZ ZN8260	1		
Z103		TRANSFORMER: r-f 23 MC Pan Part ZN8261	AZ ZN8261	1		
Z104		TRANSFORMER: coil, oscillator, 22.5 MC Pan Part ZN8262	AZ ZN8262	1*		
		TRANSFORMER: coil, oscillator, 22.35 MC. Pan Part ZN8415	AZ ZN8415	1**		
Z105		TRANSFORMER: r-f, coil, trapped, 500 KC. Pan Part ZN8263	AZ ZN8263	1*		
		TRANSFORMER: r-f, coil, trapped, 650 KC.	AZ ZN8263	1**		
Z106		TRANSFORMER: r-f, 500 KC. Pan Part ZN8264	AZ ZN8264	1*		
		TRANSFORMER: r-f, 650 KC. Pan Part ZN8416	AZ ZN8416	1**		
Z107		TRANSFORMER: r-f, 500 KC. Pan Part ZN8265	AZ ZN8265	1*		
		TRANSFORMER: r-f, 650 KC. Pan Part ZN8417	AZ ZN8417	1**		
Z108		COIL: Low pass filter. Pan Part ZN8266	AZ ZN8266	1		

* Used in equipment having serial numbers 23H116 and below, 24J141 and below.
** Used in equipment having serial numbers 23J117 and above, 24K142 and above.

LIST OF REPLACEABLE PARTS FOR MODEL DA-1

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn	Unit Price
C1		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	19		
C2		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C3		CAPACITOR: fixed, silvered mica, 51 uuf, ±5%. Pan Part CM15C510J	AP CM-15	4		
C4		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C5		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C6		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C7		CAPACITOR: fixed, silvered mica, 51 uuf, ±5%. Pan Part CM15C510J	AP CM-15	-		
C8		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C9		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C10		CAPACITOR: fixed, silvered mica, 51 uuf, ±5%. Pan Part CM15C510J	AP CM-15	-		
C11		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C12		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C13		CAPACITOR: fixed, silvered mica, 51 uuf, ±5%. Pan Part CM15C510J	AP CM-15	-		
C14		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn	Unit Price
C15		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C16		CAPACITOR: fixed: ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C17		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C18		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C19		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C20		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C21		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C22		CAPACITOR: electrolytic, 2 x 15 uf, 450 V. Pan Part CE32X150R-1	BD TVL2753	1		
C23		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C24		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
F1		FUSE: cartridge, 2 A, 250 volt. Pan Part F1003	AF AGC-2	2		
F2		FUSE: cartridge, 2 A, 250 volt. Pan Part F1003	AF AGC-2	-		
I1		LAMP: pilot. Pan Part B1007	AN 47	1		
J1		CONNECTOR: receptacle, r-f, Series N. Pan Part J1061	AD 82-24	2		
J2		CONNECTOR: receptacle, r-f, Series N. Pan Part J1061	AD 82-24	-		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn	Unit Price
J3		CONNECTOR: receptacle, 5 pin female. Pan Part J2018	AL C5-20S-VRN	1		
L1		COIL: input, step up. Pan Part ZN8320	AZ ZN8320	1		
L2		COIL: coupling. Pan Part ZN8213	AZ ZN8213	1		
L3		COIL: coupling. Pan Part ZN8214	AZ ZN8214	1		
L4		COIL: coupling. Pan Part ZN8215	AZ ZN8215	1		
L5		COIL: coupling. Pan Part ZN8216	AZ ZN8216	1		
L6		COIL: reactor, filter choke, 8 hy, 85 ma, 250 ohms. Pan Part L2008	AH C-1709	1		
L7		COIL: air, 6 turn. Pan Part L2064	AZ L2064	1		
L8		COIL: choke. Pan Part L2065	AZ L2065	1		
P3		CONNECTOR: plug, miniature, 5 contact, male. Pan Part P2024	AL C5-20P-VS/38	1		
R1		RESISTOR: fixed, composition, 200 ohms, ±5%, 1/2 W. Pan Part RC20BX201J	AC EB2015	1		
R2		RESISTOR: fixed, composition, 100 ohms, ±5%, 1/2 W. Pan Part RC20BX101J	AC EB1015	2		
R3		RESISTOR: fixed, composition, 47,000 ohms, ±5%, 1 W. Pan Part RC32BX473J	AC GB4735	2		
R4		RESISTOR: fixed, composition, 47,000 ohms, ±5%, 1 W. Pan Part RC32BX473J	AC GB4735	-		
R5		RESISTOR: fixed, composition, 7,500 ohms, ±5%, 2 W. Pan Part RC42BX752J	AC HB7525	1		
R6		RESISTOR: fixed, composition, 240 ohms, ±5%, 1/2 W. Pan Part RC20BX241J	AC EB2415	3		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn	Unit Price
R7		RESISTOR: fixed, composition, 1,500 ohms, ±5%, 1/2 W. Pan Part RC20BX152J	AC EB1525	1		
R8		RESISTOR: fixed, composition, 240 ohms, ±5%, 1/2 W. Pan Part RC20BX241J	AC EB2415	-		
R9		RESISTOR: fixed, composition, 1,200 ohms, ±5%, 1/2 W. Pan Part RC20BX122J	AC EB1225	1		
R10		RESISTOR: fixed, composition, 240 ohms, ±5%, 1/2 W. Pan Part RC20BX241J	AC EB2415	-		
R11		RESISTOR: fixed, composition, 4,700 ohms, ±5%, 1/2 W. Pan Part RC20BX472J	AC EB4725	1		
R12		RESISTOR: fixed, composition, 100 ohms, ±5%, 1/2 W. Pan Part RC20BX101J	AC EB1015	-		
R13		RESISTOR: fixed, composition, 150 ohms, ±5%, 1/2 W. Pan Part RC20BX151J	AC EB1515	5		
R14		RESISTOR: fixed, composition, 150 ohms, ±5%, 1/2 W. Pan Part RC20BX151J	AC EB1515	-		
R15		RESISTOR: fixed, composition, 150 ohms, ±5%, 1/2 W. Pan Part RC20BX151J	AC EB1515	-		
R16		RESISTOR: fixed, wirewound, 5,000 ohms, 10 W. Pan Part RW10X502-6	BG FRL-10	1		
R17		RESISTOR: fixed, composition, 6,800 ohms, ±5%, 2 W. Pan Part RC42BX682J	AC HB6825	1		
R22		RESISTOR: fixed, composition, 56 ohms, ±5%, 1/2 W. Pan Part RC20BX560J	AC EB5605	2		
R23		RESISTOR: fixed, composition, 390 ohms, ±5%, 1/2 W. Pan Part RC20BX391J	AC EB3915	1		
R24		RESISTOR: fixed, composition, 56 ohms, ±5%, 1/2 W. Pan Part RC20BX560J	AC EB5605	-		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn	Unit Price
R25		RESISTOR: fixed, composition, 82 ohms, ±5%, 1/2 W. Pan Part RC20BX820J	AC EB8205	2		
R26		RESISTOR: fixed, composition, 91 ohms, ±5%, 1/2 W. Pan Part RC20BX910J	AC EB9105	1		
R27		RESISTOR: fixed, composition, 82 ohms, ±5%. 1/2 W. Pan Part RC20BX820J	AC EB8205	-		
R28		RESISTOR: fixed, composition, 150 ohms, ±5%, 1/2 W. Pan Part RC20BX151J	AC EB1515	-		
R29		RESISTOR: fixed, composition, 39 ohms, ±5%, 1/2 W. Pan Part RC20BX390J	AC EB3905	1		
R30		RESISTOR: fixed, composition, 150 ohms, ±5%, 1/2 W. Pan Part RC20BX151J	AC EB1515	-		
R31		RESISTOR: fixed, composition, 300 ohms, ±5%, 1/2 W. Pan Part RC20BX301J	AC EB3015	2		
R32		RESISTOR: fixed, composition, 18 ohms, ±5%, 1/2 W. Pan Part RC20BX180J	AC EB1805	1		
R33		RESISTOR: fixed, composition, 300 ohms, ±5%, 1/2 W. Pan Part RC20BX301J	AC EB3015	-		
S1		SWITCH: toggle, DPST. Pan Part S1028CH	AE ST22K	1		
S2		SWITCH: toggle, DPDT. Pan Part S2009CH	AE 20905	4		
S3		SWITCH: toggle, DPDT. Pan Part S2009CH	AE 20905	-		
S4		SWITCH: toggle, DPDT. Pan Part S2009CH	AE 20905	-		
S5		SWITCH: toggle, DPDT. Pan Part S2009CH	AE 20905	-		
T1		TRANSFORMER: power. Pan Part T3004	AH PM8409	1		
V1		TUBE: Type 6J4. Pan Part 6J4	BZ 6J4	3		

Circuit Ref. Symbol.	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn	Unit Price
V2		TUBE: Type 6J4. Pan Part 6J4	BZ 6J4	-		
V3		TUBE: Type 6CB6. Pan Part 6CB6	BZ 6CB6	3		
V4		TUBE: Type 6CB6. Pan Part 6CB6	BZ 6CB6	-		
V5		TUBE: Type 6CB6. Pan Part 6CB6	BZ 6CB6	-		
V6		TUBE: Type 6J4. Pan Part 6J4	BZ 6J4	-		
V7		TUBE: Type 5Y3. Pan Part 5Y3	BZ 5Y3	1		
V8		TUBE: Type OA2. Pan Part OA2	BZ OA2	1		
XV1		SOCKET: tube, 7 pin miniature. Pan Part X1105	AO 305BC	7		
XV2		SOCKET: tube, 7 pin miniature. Pan Part X1105	AO 305BC	-		
XV3		SOCKET: tube, 7 pin miniature. Pan Part X1105	AO 305BC	-		
XV4		SOCKET: tube, 7 pin miniature. Pan Part X1105	AO 305BC	-		
XV5		SOCKET: tube, 7 pin miniature. Pan Part X1105	AO 305BC	-		
XV6		SOCKET: tube, 7 pin miniature. Pan Part X1105	AO 305BC	-		
XV7		SOCKET: tube, octal. Pan Part X1020	BH 115001-1NS	1		
XV8		SOCKET: tube, 7 pin miniature. Pan Part X1105	AO 305BC	-		

LIST OF REPLACEABLE PARTS FOR MODEL PS-8b

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn	Unit Price
C1 A,B		CAPACITOR: electrolytic, plug-in, octal base, 2 x 20 uf, 450 vdc. Pan Part CE52X200R-1	BD PE-2755	1		
C2 A,B		CAPACITOR: fixed, paper, oil-filled, rectangular, 2 x .25 uf, 2000 vdc. Pan Part CP70D6XJ254X-5	AT CGF-7071	3		
C3 A,B		CAPACITOR: fixed, paper, oil-filled, rectangular, 2 x .25 uf, 2000 vdc. Pan Part CP70D6XJ254X-5	AT CGF-7071	-		
C4		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	2		
C5		CAPACITOR: fixed, ceramic disc, .01 uf, 500 vdc. Pan Part CC2003-17	AC 36-103W	-		
C6 A,B		CAPACITOR: fixed, paper, oil-filled, rectangular, 2 x .25 uf, 2000 vdc. Pan Part CP70D6XJ254X-5	AT CGF-7071	-		
CR1		RECTIFIER: selenium, 5 milli-amperes, 2000 V. Pan Part CR2005	AW V100HF	2		
CR2		RECTIFIER: selenium, 5 milliamperes, 2000 V. Pan Part CR2005	AW V100HF	-		
F1		FUSE: cartridge, 2 amperes, 250 V. Pan Part F1003	AF AGC2	2		
F2		FUSE: cartridge, 2 amperes, 250 V. Pan Part F1003	AF AGC2	-		
J1		RECEPTACLE: twistlock, male, 3-wire. Pan Part J1002	AU 7486	1		
J2		RECEPTACLE: box mounting, female, 14 contact, solid shell. Pan Part J2008	AD MS-3102A-28-2S	1		
L1		REACTOR: filter, 8 Hy. Pan Part L2015	AS 1F231	2		

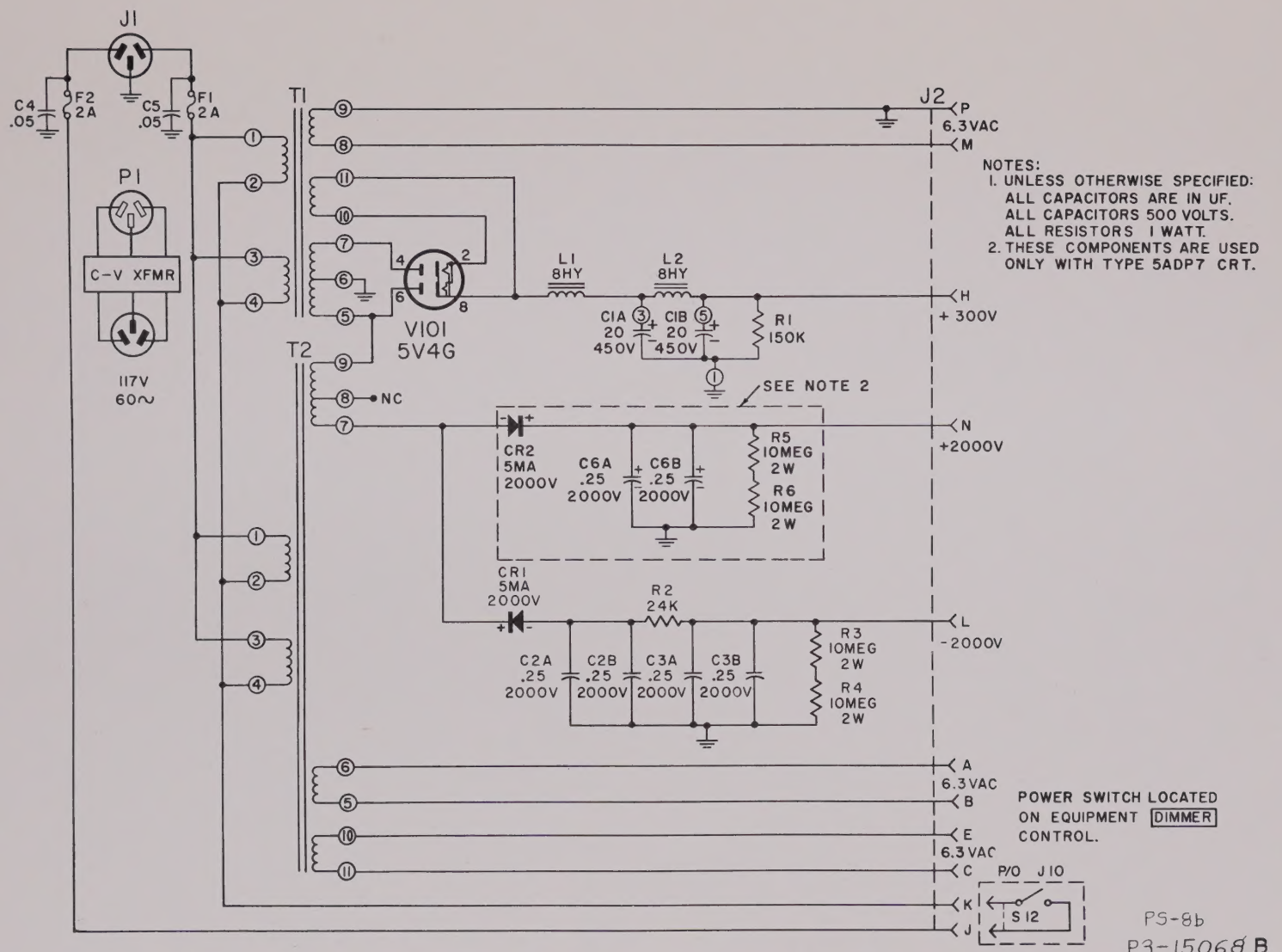
Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn	Unit Price
L2		REACTOR: filter, 8 Hy. Pan Part L2015	AS 1F231	-		
R1		RESISTOR: fixed, composition, 150,000 ohms, ±5%, 1 W. Pan Part RC32BX154J	AC GB1545	1		
R2		RESISTOR: fixed, composition, 24,000 ohms, ±5%, 1 W. Pan Part RC32BX243J	AC GB2435	1		
R3		RESISTOR: fixed, composition, 10 megohms, ±5%, 2 W. Pan Part RC42BX106J	AC HB1065	4		
R4		RESISTOR: fixed, composition, 10 megohms, ±5%, 2 W. Pan Part RC42BX106J	AC HB1065	-		
R5		RESISTOR: fixed, composition, 10 megohms, ±5%, 2 W. Pan Part RC42BX106J	AC HB1065	-		
R6		RESISTOR: fixed, composition, 10 megohms, ±5%, 2 W. Pan Part RC42BX106J	AC HB1065	-		
T1		TRANSFORMER: low voltage. Pan Part T3-9877B	AZ T3-9877B	1		
T2		TRANSFORMER: high voltage. Pan Part T3-9875C	AZ T3-9875C	1		
V101		ELECTRON TUBE: 5V4G. Pan Part 5V4G	BZ 5V4G	1		
XF1		FUSE HOLDER: extractor type. Pan Part F2010	AY 342003	2		
XF2		FUSE HOLDER: extractor type. Pan Part F2010	AY 342003	-		
XV101		SOCKET: octal. Pan Part X1020	BH 115001-1NS	1		

CONSTANT-VOLTAGE TRANSFORMER REPLACEABLE PARTS

C1		CAPACITOR: oil-filled, 3.5 uf, 660 vac. Pan Part CP2022	AR URCAT 49F714	1		
P1		CONNECTOR: plug, 3 wire, female. Pan Part P1005	AU 7484	1		

MANUFACTURERS CODE FOR LIST OF REPLACEABLE PARTS

AA	Aerovox Corporation
AB	Alden Products Company
AC	Allen-Bradley Company
AD	Amphenol-Borg Electronics Corporation
AE	Arrow-Hart & Hegeman Electric Company
AF	Bussman Fuse Division of McGraw Edison Company
AG	Centralab Division of Globe Union Corporation
AH	Chicago Standard Transformer Corporation
AI	Chicago Telephone Supply Corporation
AJ	Cinch Manufacturing Corporation
AK	Clarostat Manufacturing Company
AL	Continental Connector Company
AM	Cornell Dubilier Electric Corporation
AN	Dialight Corporation
AO	Elco Corporation
AP	Electro Motive Manufacturing Company
AQ	Erie Resistor Corporation
AR	General Electric Company
AS	General Transformer Company
AT	Gudeman Company
AU	Harvey Hubbell Incorporated
AV	Industrial Condenser Corporation
AW	International Rectifier Corporation
AX	International Resistance Company
AY	Littelfuse Incorporated
AZ	Panoramic Radio Products Incorporated
BA	Radio Receptor Corporation
BB	Sangamo Electric Company
BC	Sprague Electric Company
BD	Sprague Products Corporation
BE	Stackpole Carbon Company
BF	Teleradio Engineering Company
BG	Tru-ohm Products Division of Model Engineering & Manufacturing Inc.
BH	United-Carr Fastener Corporation
BI	Ward Leonard Electric Company
BZ	Any EIA Manufacturer



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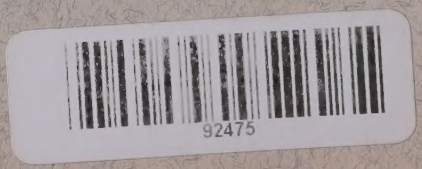
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